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Impact of Personality Traits and Team Criteria on Construction Team Performance

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IMPACT OF PERSONALITY TRAITS AND TEAM CRITERIA ON CONSTRUCTION TEAM PERFORMANCE

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ABSTRACT

This dissertation investigated how personality traits and team criteria influence team performance in real construction projects. Though personality influence on team performance has been significantly investigated in other business sectors, the literature revealed that the construction industry lacks investigations regarding personality influencing team performance. The existing literature revealed that the Big Five Factors (BFF) was the most popular assessment tool for personality. Thus, this dissertation adopted the 50-Item Personality questionnaire developed by Goldberg, which consited of extraversion, aggreeableness, conscientiousness, neuroticism, and openness to experience. The literature also revealed several common team criteria to evaluate team performance: team member satisfaction, shared values/goals/culture, commitment/responsibility, communication/information sharing, and trust/respect. This investigation aimed to find what personality traits influence team performance in construction projects and determine the accuracy of the personality traits and team criteria conditions. The qualitative comparative analysis (QCA) revealed that personality traits influence team performance only in combination with team criteria. It also revealed that agreeableness, conscientiousness, and openness to experiance are the most influential traits in the sampled construction projects. QCA also revealed team criteria conditions were the most influential and that trust and respect must be present in construction teams to achieve high team performance. This dissertation provided valuable findings to the construction industry by demonstrating that personality traits and team criteria are influence team performance. The practical implication of the results is that construction stakeholders must value trust/respect and use personality, especially agreeableness, to access and maintain trust/respect levels during the project's construction phase.

CHAPTER 1. INTRODUCTION

1.1 Personality and Team Performace

Despite the common notion that project success is associated with a well-developed plan coordinated with a committed project team (Thomas, Jacques, & Kihneman-Wooten, 2008), construction project teams are subject to many factors, such as personality differences, which can impede project success (Albanese, 1994; Goldberg, 1990; O'Neill & Allen, 2010; Wang & Zhang, 2015). Experienced professionals working on construction projects hear things such as, "It was the inspector's fault", "It was the subcontractor's fault", or "The project manager failed the team". On the other hand, it is rare to hear, "We failed as a team, let's see what we can do about it". The first type of comments can create mistrust among team members, and individualistic objectives start forming among the principal team members.

In response, researchers in the construction industry have addressed some issues that project teams experience during project's design and construction, by developing guidance and frameworks to integrate project teams. Yet, these tools and information fail to address personality differences among the team members. Frameworks that concentrate in project planning and project controls are excellent for utilization, but they still require that team members are willing to work together to implement and use them on the field (Thomas et al., 2008). Tuckman (1965) explains that any team or group, independent of the environment in which they interact, must work together to accomplish a task successfully. Moreover, team members must relate to each other interpersonally, with tasks as contents of interaction. It is at this content of interactions where personality differences become apparent, which can lead to issues that can escalate into a loss of team performance. However, to address personality difference and the interaction that occurs between team members, a measurement procedure or methods are needed, and the literature review should assist in finding a developed psychometric method that could be utilized.

There several ways to measure personality, but which one do we deem adequate to measure personality in construction teams? To answer the question, a literature review content had to be performed to understand how personality affected team performance. The construction industry still operates under the same basic principle: taking a team of well-experienced people to carry out the design and the construction. This is crucial, as projects' complexity and team involvement becomes frequent (Kumaraswamy, Yng Ling, Rahman, & Phng, 2005). Kumaraswamy (2005) explains that there are approaches wherein trust and cooperation can be built by teaching basic team-building techniques (Kumaraswamy et al., 2005). However, it will depend on the kind of attitude or personality the team member expresses during the construction phase. During the construction phase, there are many moments when team members agree, but, unfortunately, there are also moments when they disagree. Some causes of disagreements can be due to personality differences (Sarason & Holzman, 1999). The focus point is ultimately the team member, since they are carriers of the personality variability that researchers want to study and understand (Carlson, 1971). Therefore, different personality characteristics become inferences by the observer, when interacting in social environments with personality characteristics as elements of interaction (Sarason & Holzman, 1999). Consequently, this is the critical aspect that the investigation is trying to measure. However, we must understand how personality affects performance by investigating the Big Five Factors.

We cannot understand team members' motives or actions without first understanding what drives a person to perform well or badly at a specific task. Thus, we must understand different methods for explaining human behavior, such as "trait theory" and "social cognitive perspective", which have become one to create what is known today as personality traits.

Two popular 20th century theories that try to address personality testingand measurement are trait theory and social cognitive perspective. Trait theory investigators describe personality through steady and lasting behavior configurations and mindful motivations. Allport (1937) explained the necessity to look at behavior rationales in the present, rather than the past, to portray behaviors, defining personality as “fundamental traits, or characteristic behaviors and conscious motives” (Allport, 1937). Modern investigators like McCrae and Costa (1989) have prearranged these fundamental characteristics of personally into the big five: extraversion (EX), agreeableness (AG), conscientiousness (CO), neuroticism (NE), and open to experience (OP). Each personality trait exists on a spectrum that describes the lows and highs of personality scales, described in Table 1.1.

Table 1.1. Personality Traits Spectrum. Adapted from Gray (2017) - https://sites.psu.edu/leadership/2017/09/02/the-importance-of-personality-trait-screening-for-todays-organizations-application-of-the-five-factor-model-ffm/

Low Spectrum	Personality Trait	High Spectrum
Disorganized, careless, & impulsive	Conscientiousness	Organized, careful, & disciplined
Ruthless, suspicious, & uncooperative	Agreeableness	Soft-hearted, trusting, & helpful
Calm, secure, & self-satisfied	Neuroticism (emotional stability vs instability)	Anxious, insecure, & self-pitying
Practical, prefers routine, & conforming	Open to Experience	Imaginative, prefers variety, & independent
Retiring, sober, & reserved	Extraversion	Sociable, fun-loving, & affectionate

The critical idea behind personality traits is that behavior and attitude can be predicted. For example, an extravert might prefer to interact with a team to solve an issue, and an introvert might prefer to work alone and present a solution to the rest of the team to follow. A team member high on conscientiousness might o be organized, careful when making decisions, and consistent in task completion. A team member with low conscientiousness might tend to be impulsive, irresponsible, and disorderly (Driskell, Goodwin & Shea, 2006). Team members with high neuroticism or a low position on emotional stability can be disadvantageous to a team, because they might have a hard time coordinating with others, exhibiting impulsive behaviors, and lowself-confidence (Driskell et al., 2006; Juhász, 2010; O’Neill & Allen, 2010). Team members with a high placement in open-to-experience dimension might have skills necessary for decision-making and communication. The low end of open-to-experience will be reserved for a team member who might not accept changes (Driskell et al., 2006). Finally, team members high on agreeableness tend to be trusting, supportive, honest, and cooperative with the rest of the team (Bradley, Klotz, Postlethwaite, & Brown, 2012; Chow, Then, & Skitmore, 2005; Driskell et al., 2006; O'Neill & Allen, 2010).

However, the traits can also be flexible, depending on the environment owith which the person is interacting. For example, an introvert might work in a team underthe right conditions. Therefore, personality traits are much better at predicting the average behavior of a person than specifically stating what that person will do exactly in a specific situation (Driskell et al., 2006; O'Neill & Allen, 2010).

The social-cognitive perspective is the second major theory which tries to explain the interaction between personality traits and the social context, as proposed by Bandura (1986). Bandura (1986) describes that people's behavior is learned by observing and imitating others, which represents the social aspect. Bandura also contends that people consider how these social interactions affect their behavior, which is the cognitive aspect. As a result, behaviors become a product of people's interactions (kind of friends, movies, books, music, education, etc.), depending on different situations that describe someone's personality, which was defined by Bandura as "reciprocal determinism." Therefore, interacting in different project locations with different team members either reinforces members' personality traits or discourages them from acting out of their real personality characteristics. Regarding the information above, an adequate method of personality testing and measuring has to be carefully selected, considering how it affects team performance. The major goal of predicting behavior is to assess team performance, and, as this behavior can be comparable in similar projects, it is possible to predict a team's behavioral pattern. Therefore, construction leaders can assess their team members better and deicde how this baseline behavioral pattern can be used to predict performance.

1.2 Measuring Personality

Personality or human behavior has been much investigated.There is no specific date when it started, but Goldberg (1971) approximates that the first investigation of personality scales and inventories started in 1906, with the Developed Symptom List by Heymans and Wiersma published in 1906. Goldberg (1971) provided an extended historical list of other investigations dedicated to personality traits, that lasted from 1906 to 1970. In modern society, there is a vast number of personality tests provided to the public, either for free or for a price per test. See Table 1.2 for a detailed list of the most popular methods.

Table 1.2. Popular Tests for Measuring Personality

Personality Test	Created by	Objective
The Myer-Briggs Type Indicator (MBTI)	Katherine Briggs and daughter Isabel Myers	Determines personality differences and finds the ways these differences are used with perception & judgment (MBTI Foundation, n.d.).
Adjective Check List	Harrison G. Gough, Ph.D. and Alfred B. Heilbrun, Jr., Ph.D.	Consists of 300 adjectives and adjectival phrases commonly used to describe person's attributes (Gough & Heilbrun, 1983).
Big Five Personality Traits (BFPT) or Five Factor Model (FFM)	Originally seen in the temperament investigation by Cattell (1933) & Fiske (1949) but later reintroduced by Costa & McCrae; Digman & Takemoto-Chock and Goldberg (1981); John, Angleitner, and Ostendorf (1988); and McCrae and Costa (1989)	Utilizes the five global factors (extraversion, conscientiousness, agreeableness, open to experience, and neuroticism) to describe personality based on common language (Digman, 1997; Goldberg, 1971).
California Psychology Inventory (CPI)	Harrison G. Gough	Examines personality utilizing 194 items/scales, which focus on ordinary behaviors to describe personality (Gough, 1985)
Goldberg's Five Factor Markers (GFFM)	Lewis R. Goldberg	To provide a revised and more comprehensive set of Big Five Factors (Goldberg, 1992).
Goldberg's International Personality Item Pool (IPIP)	Lewis R. Goldberg	Open-source personality measure utilizing 3,000 items and over 250 scales (Goldberg et al., 2006; Goldberg, 1999).
Neo Personality Inventory (NPI) and revised (NEO-	Costa and McCrae's	Measures personality using the five basic personality factors (McCrae & Costa, 2004).

The methods in Table 1.2 have different approaches to determining personality types. For this investigation, the modern Trait Personality approach will be utilized to test and measure personality by having participants and team members answer a series of questions related to team performance. Personality trait inventories, such as The Big Five or the Goldberg's International Personality Item Pool (IPIP) are the most accessible methods to obtain the scales to conduct personality evaluations. IPIP is the most interesting for this investigation, because it is a public domain (open-source) and provides the necessary steps to utilize the IPIP method. It also ensures scales' reliability and validity by providing coefficient alpha values (Goldberg et al., 2006; Goldberg, 1999)

1.3 The Big Five

The Big Five was a result of several investigations that concluded that personality scales can be grouped into five major traits/factors: 1) EX, 2) AG 3) CO, 4) NE, and 5) OP (Gibby & Zickar, 2008; Goldberg, 1993). The most convenience aspect of the Big Five Factors is that they can be found in other personality methods, such as the Adjective Check List (ACL). Another advantage is that personality tests can be considerably shorter, which should prevent participants from selecting the same answer throughout the test in order to finish it quickly(Gosling, Rentfrow, & Swann, 2003). However, when conducting shorter personality tests, many psychologists have implied that a less meaningful outcome could occur (Gosling et al., 2003). Saucier (1994), compared the difference in quality between a full Goldberg's Five Markers personality test and shorter "Mini-Marker" version, which contained only forty facets/markers out of 100. He concluded that a well-prepared shorter personality test can produce reasonable reliability. Soto and John (2017) also commented that the big five inventories have also provided the possibility of developing a 44 facets/markers personality test that can be completed in 5 to 10 minutes. Soto and John (2017) and Saucier (1994) also emphasized the possibility of creating a concise personality test that can be implemented in a variety of places, including the construction industry.

1.4 The IPIP Method

The IPIP method has over 3,000 relevant questionnaire items and 250 scales created from the them, which are available to the public. The IPIP items consist of short phrases, such as, “Feel comfortable around people,” and each phrase is rated using a 5-point Likert scale, ranging from “very inaccurate” to “very accurate” (Goldberg et al., 2006; Goldberg, 1999). The variety of items and scales the IPIP provides will help this study identifyitems and scales related to personality and team performance. Another advantage is that the IPIP proxies have been established and measured across many other personality inventories, such as the NEO-PI-R, 16 Personality Factor Questionnaire, California Psychological Inventory, and the Hogan Personality Inventory (Goldberg et al., 2006; Goldberg, 1999).

The IPIP method is too long to be used in its original form, also referred to as a “Long Form Personality Test.” (LFPT). As time is critical to prevent participants from getting bored or giving vague answers, many psychologists strategically select the items relevant to their research to create a short version of the LFPT that reduces the number of items (questions) from 3,000 to a reasonable number between 20 and 30 items. According to Smith, McCarthy, and Anderson (2000), the development of a short-form personality test (SFPQ) requires that the parent personality method, IPIP for this research, has to be validated and used in different investigations. Therefore, for this research, there is no need to create personality questions, but they will be strategically selected utilizing the common team attributes found in the literature. They are explained in detail in Chapter 3, under the “Field observation” section. The steps necessary for developing the SFPQ and ensuring the same validity and reliability is carry-over, are described in detail in Chapter 3, under the “Procedure for development and validity of SFPQ”. The goal will be to develop an SFPQ with a minimum of 20 items selected from the IPIP database. The validation process requires comparing the SFPQ results to the LFPT, to ensure they are reliable as in the original LFPT, which is conducted as a pilot test prior to the actual research. The SFPQ will be tested on the graduate students from the Bert S. Turner Department of Construction Department at Louisiana State University (LSU).

1.5 The Observed Problem

The construction industry uses a competition-driven business model, whereinowners build projects with high quality but at a low price, and the contractor bids the project with the intentions to profit and satisfy the owner. This competitive aspect is the traditional procurement and contracting method used throughout the construction industry, which has caused contracting parties to be isolated from each other, with project contract documents serving as checks and balances, limiting the chances of team collaboration (Franz et al., 2016). Further, construction projects with a more integrated project delivery system showed improvements in teamwork, communication, and collaboration. However, there was no assessment regarding the personality levels of team members involved in integrated projects. In other words, it is hard to tell if the integrated projects' success can be attributed to the integration program or team members' personalities. The authors claim that, in the construction industry, there are individual differences that influence project integration, such as personality, values, and backgrounds. Ultimately, project delivery methods that could provide more integrated and cohesive teams can be influenced by the primary team members responsible for completing the project (Franz et al., 2016). Advantages from well-defined project planning or selected project delivery will be dependent on the team members' ability to communicate, cooperate, collaborate, and trust each other (Spatz, 2000).

Construction team members have the necessary technical skills and knowledge to accomplish the tasks, and construction contractors and owners utilize project planning to assist the team in accomplishing these tasks. However, issues regarding failure to accomplish certain tasks can be attributed to the technical training and educational background, which is commonly focused on technical features and not interpersonal skills, i.e. working with a team across contractual bounds (Juhász, 2010; Thomas et al., 2008). Therefore, technical skills and well-defined planning are necessary but not satisfactory to ensure team performance, which can be affected by team members' interactions, also known as an intragroup process.

Juhász (2010) describes intragroup process is the factor influenceing team performance, which refers to the team members' interactions and comprises patterns such as conflict, communication, and trust. For example, if we have a team wherein the majority of the members are high on extraversion, the team will be more likely to have issues in leadership, dividing responsibilities, and completing specialized work items (Kramer, Bhave, & Johnson, 2014).

Since construction projects are complex and usually working on tight budgets and schedules, team members are expected to perform efficiently (Spatz, 2000). The expectations, in return, become sub-factors of the intragroup process, wherein team members have to rely on honest communication, reliance, and delivery of outcomes (Khalfan, Mcdermott, & Swan, 2007); ultimately, building the level of trust the team will inherit for the duration of the project. Trust building becomes a process during the design or construction phase, and, in some circumstances, during the completion of many projects (Khalfan et al., 2007). However, with traditional delivery methods as most commonly used in publicly-funded projects, building trust becomes a problem when teams are obligated to compete against each other to complete the project. Also, there is a high chance that teams will not work again for a long time.

1.6 Problem Statement and Research Questions

The construction industry is a labor-intensive business, requiring managers to work and manage people with different skills, knowledge, and personalities, in order to achieve success. Increasing construction complexity and substantial project requirements are forcing construction team members to operate by valuing team integration, collaboration, and cooperation, which are necessary aspects of team performance and, ultimately, project success. Team members working in cohesion and collaboration during the construction phase can potentially dictate a level of success that can only be achieved depending on the level of their willingness to work together, which reflects personality. However, each member is different in professional achievement and experiences gained. Additionally, these differences influence how each member prioritizes situations, makes decisions, pursues relationships, develops trust in those relationships, and collaborates. Thus, these differences become a part of the personality characteristics of each team member, with the possibility of impacting team effectiveness (Goldberg, 1990; Wang & Zhang, 2015). On the other hand, the construction industry requires people to have different skills from different study areas and management principles, while, at the same time, working as a team to exchange information, complete tasks, and accomplish common goals (Wang & Zhang, 2015).

In traditional construction delivery, the contractor and designer assume individual roles as dictated by the contract, which forces each party to consider risks individually instead of jointly. As a consequence, the opposite party does not have an obligation or an initiative to support the other when issues arise (Kumaraswamy et al., 2005), which leads to a lack of cooperation among the primary stakeholders and project team members, translating into delays, claims, and trust issues.

There are constraints that prevent team members from completely integrating with one another. One constraint is the lack of a previous working relationship with other team members, which can create difficulties in functioning as a team when trying to understand the motives of others, which people do not know until they interact with one another for a period of time (Che Ibrahim, Costello, & Wilkinson, 2015). Another constraint is that team members come from a variety of firms and agencies, which have different professional values regarding their organization, resulting in potential conflict during the construction phase (CheIbrahim et al., 2015). Personality characteristics could assist in either easing these constraints, or they can give members a hard time building working relationships and accepting professional values imposed by their own firms.

Consequently, the intent of this study is to investigate the impacts of personality traits on team performance in construction projects, in conjunction with team criteria. To begin to understand personality traits and their influence on team performance, a control mean is needed. The control mean was obtained by conducting a meta-analysis of selected construction team literature collected from prominent online libraries and databases for construction management and engineering. Chapter 2 explains the details, steps, and results of obtaining the control mean from the meta-analysis.

1.7 Purpose of Research Questions

The objective of this study is to learn if personality differences influence construction team performance and the project's success. The literature review has provided information regarding frameworks and improved delivery systems, such as Integrated Project Delivery, Design-Build, and Contractor Manager at Risk, with the purpose to integrate projects and teams. However, the literature review has also shownthat, in order to implement new methods that assist team integration or cohesion, team members need to be willing to work together despite their personality differences. To further assist the investigation and the formulation of the research questions, a research statement was created. Below is the research statement, followed by the research questions.

1.8 Research Statement

"Construction team members' personality has an influence on team performance."

The research questions that will address the main objective of this study are as follows:

Q1 - Which personality traits can influence team performance?

Q2 -How do personality traits influence team performance?

Q3 - What personality traits influence team performance on construction projects?

Q4 - How accurately can personality traits and team criteria influence team performance on construction projects?

1.9 Research Question 1

The first question is to determine the specific personality traits with the biggest influence on team performance. From the literature review, studies show that personality influences the general team performance, since personality characteristics are affected by the environment (Barrick & Mount, 1991; Barry & Stewart, 1997; Bell, 2007; Bradley et al., 2012; O'Neill & Allen, 2010; Peeters, Rutte, Van Tuijl, & Reymen, 2008; Prewett, Walvoord, Stilson, Rossi, & Brannick, 2009). The literature included a vast number of studies investigating personality and team performance utilizing subjects such as: 1) business, 2) students, and 3) engineering. However, the literature review lacked information on the evaluation of personality and team performance for construction projects. Although most studies are not directly related to construction project teams, they provide some insight into how personality influences team performance. Therefore, using a meta-analysis of studies conducted on personality and team performance, the response to this question will focus on its findings, as shown in Chapter 2 of this reserach dissertation.

1.10 Research Question 2

Question one focuses on determining the correlation mean (influece effect) that each personality trait has in relation to team performance. Therefore, question two will focus on finding out if there is a meaningful connection between personality traits and team performance. The review of relevant studies should give an indication of personality traits's influence on team performance, clarifying how personality characteristics assist team members to be a part of the team, to communicate, understand other team members, achieve common objectives, to take initiative, be willing to accept change, and trust others. This will be accomplished by including other industries, such as business, education, military, and engineering, besides construction, tounderstand betterhow the BFF traits have influenced team performance in these industries.

1.11 Research Question 3

Question one and two provide information on the mean correlation for team performance and how the BFF traits influence team performance. Question three will use the data collected from actual projects to determine if the same traits found in the literature review influence team performance in construction project typesetting. To answer question three, a cross-comparison between the literature review and the sampled case studies is needed, to explore and assess if all or only some personality traits influence team performance. Since the construction industry does not take consider personality when selecting delivery methods and project planning, answering question three should give a better understanding of personality traits and their influence on team performance. It should also help construction leaders assess team member personality and interpret the outcomes, as they are related to team performance.

1.12 Research Question 4

Question four consists of determining if personality traits and team criteria, used to measure team performance, can accurately demostrate influence on construction team performance based on the personality traits that are the most influential. The accuracy of the results will be the final finding of this research, which will take team members' personality trait levels to identify which traits have weaknesses (low scores) to provide the proper guidance for their mitigation. Moreover, the results will be shared with construction experts and psychologists, who will assist in discussing and evaluating the results. This process will also serve as an external validity to strengthen the results with the possibility of finding more opinions on future research.

1.13 Point of Departure and Contribution to the Body of Knowledge

The literature review revealed a few studies regarding personality and its influence on team performance, specifically for construction projects. Therefore, the findings gained from this study will contribute to the construction research body of knowledge by investigating the influence of personality traits on construction team performance and using personality traits to encourage the continuation of exploring behavior influencing team performance in the construction industry. With more investigations, a prediction model could be created that is more specific to the construction indutr. Principal stakeholders could use it to predict team performance during the construction phase. The study's results will provide construction leaders with a better assessment of their team members' behaviors and interactions and how behavior patterns can be used to access performance during construction.

1.14 Research Deissertation Format

The following chapters provide detailed information regarding this research project. It will address the information obtained from the meta-analysis conducted on team performance studies wherein BFF traits were analyzed and correlated to team performance. Then, the research methodology completed and proposed will be detailed for review, including data collection and analysis plan, as well as a study timeline . Below is a list of the chapters in this researh dissertation:

- Chapter 1 - Summarizes the background for this research and leads the rest of the proposal.
- Chapter 2 - A meta-analysis of the BFF personality traits for decision-making related to team performance in the construction industry.
- Chapter 3 - Methodology used to conduct data collection and analysis.
- Chapter 4 - Analysis procedures and summary of the findings seeking to answer research questions three and four.

- Chapter 5 - Discussion of the findings, contribution to the boddy of kowledge, implications of the findings, limitations of the study, and recommendations for future research and practice.

1.15 Chapter 1 Conclusion

To conclude, there will always be variability of personalities among team members, and, as the construction industry is a labor-intensive industry, team members should focus on working together to solve issues that arise and achieve the set project goals. Therefore, a team performance accessment tool can assist construction leaders to address team performance inconsistencies due to different personality traits and its influence on team performance. The results of this study should clarify what levels of personality traits exist in construction projects to better understand team member's motivation based on perosnality.

CHAPTER 2. REVIEW OF PERSONALITY TRAITS INFLUENCING TEAM PEFORMANCE

2.1 Introduction

The construction industry is a labor-intensive business and requires managers to focus on collaboration, cooperation, and team integration to solve common issues and achieve project goals. Therefore, the team member selection must consider team building and collaboration. Also, with the complexity of the construction projects and the requirements of project integration, has obligated the team member selection process to analyze the understanding of personality characteristics correlated with team performance and team cohesion. The reason behind this is that personality characteristics of team members impact team effectiveness (Goldberg, 1990; Wang & Zhang, 2015). The construction industry requires people with different skills, study fields, and management principles, but who work as a team to exchange information and accomplish common goals (Wang & Zhang, 2015).

Construction projects' teams are either inter-organizational or intra-organizational (Albanese, 1994). This paper will concentrate on the inter-organizational team, which is composed of representatives such as the project owner, designer, contractor, consultant, and subcontractor, who have a direct impact on team effectiveness and project success. Team building is a part of this study because it requires team members to work together to meet project goals (Albanese, 1994). Team building assists team cohesion and collaboration by developing a common purpose, common goal/objectives, while creating trust among members and promoting problem-solving characteristics among all team members (Albanese, 1994). According to Albanese (1994), team building might be an issue if team members are not willing to work together due to personality differences.

A team is composed of members who have individual characteristics, such as personality, demographics, attitudes, and cultural background, (O'Neill & Allen, 2010) which impact team performance and efficiency, depending on the type of task and project location. Therefore, the Big Five Factors (BFF) and the Adjective Check List (ACL) personality traits will be reviewed to see how they might assist in the team member selection. O'Neill and Allen (2010) suggested that a certain weight of the BFF could be appropriately used to predict team performance. The ACL will be utilized with BFF to have more access to different facets that might be more related to construction team performance and effectiveness. It was decided to use both methods because Piedmont, McCrae, and Costa (1991) tested the correlation between ACL scales with those of the five-factor model (FFM). The authors analyzed the results using the principal components extraction with varimax rotation. They concluded the 35 ACL scales and the FFM have a striking resemblance, and that the FFM scales can be embedded in the ACL method (Piedmont, McCrae, & Costa, 1991).

2.2 Extraversion

Team members with high extraversion tend to be dominant, but, at the same time, they are very sociable, which tends to be a strong predictor of team performance (Culp & Smith, 2001; Driskell et al., 2006; O'Neill & Allen, 2010). According to Driskell et al. (2006), facets that are relevant to team interaction extraversion are affiliation, dominance, expressivity, and social perceptiveness. When it comes to project conflicts, extroverts like to resolve issues as a team with constructive resolutions (Bradley et al., 2012). However, if the team consists mostly of extroverts, there can be an issue with a power struggle and dominance, resulting in bad performance and loss of team effectiveness (Bradley et al., 2012; O'Neill & Allen, 2010). While extroverts are very energetic, generating ideas out-loud and thinking in groups, others might find them annoying and too loud (Culp & Smith, 2001). In a construction project, team members should understand each other in order to work together well. Understanding others' personality will assist in creating a more cohesive team (Culp & Smith, 2001).

2.3 Agreeableness

Agreeableness deals with interpersonal interactions and the tendency of individuals to be more cooperative, trusting, and sympathetic (Bradley et al., 2012; Chow, Then, & Skitmore, 2005; Driskell et al., 2006; O'Neill & Allen, 2010). Driskell et al. (2006) suggested that team members high on agreeableness tend to be honest, trusting, supportive, and considerate, which helps validate team functions related to cooperation and building relationships. The trust facet has a great impact on team performance. Others tend to rely on team members who are high on trust, as they are honest and can be relied upon because they are concerned with the team's well-being (Juhász, 2010). However, the opposite is very destructive because team members believe that person lacks integrity and are looking for slip-ups in others (Driskell et al., 2006). Driskell et al. (2006) suggested the facets that are more important to team effectiveness are trust and cooperation.

2.4 Conscientiousness

Conscientious team members are likely to be ambitious, persistent, cautious, self-controlled, responsible, and clever. They are also more likely to be detail-oriented and volunteer in task-focused activities, which helps understand the task requirements and team members' responsibilities (Guchait, Hamilton, & Hua, 2014; O'Neill & Allen, 2010). O'Neill and Allen (2010) concluded in their paper that conscientiousness was significantly and positively correlated with team performance for all its facts (competence, order, dutifulness, achievement-striving, self-discipline, and cautiousness). People who are low on conscientiousness tend to be impulsive, irresponsible, and disorderly (Driskell et al., 2006). However, there are some investigators that consider conscientiousness as an individualistic trait which cannot be used to validate team performance. Such investigators are Bradley et al. (2012) who suggested that conscientiousness is the trait with facets dealing with performance at the individual level, meaning that individuals with a high conscientiousness may be inflexible and close-minded. However, this can differ depending on the needs of the team and project requirements. Juhász (2010) mentioned that conscientiousness could be positively related to team performance only when both the team and the leader's level of conscientiousness are high. Guchait, Hamilton, and Hua (2014) mentioned in their study that team members with a high conscientiousness level are likely to be detail-oriented.

2.5 Neuroticism

Neuroticism, also known as Emotional Stability (lack of anxiety and nervous tendency), is the trait that has the most negative aspects of personality characteristics. A team with a high level of neuroticism (low emotional stability) can be detrimental to team performance, cohesion, and decision making (Driskell et al., 2006; Juhász, 2010; O'Neill & Allen, 2010). People with high neuroticism have a hard time coordinating with others, exhibit impulsive behaviors, with self-confidence (Driskell et al., 2006; Juhász, 2010; O'Neill & Allen, 2010). Juhász (2010) claims that high impulsiveness under neuroticism could have a positive effect. According to the example, Juhász (2010) provided, the communication of the team member with high impulsiveness can be surer (hardly any doubts), which assists when dealing with issues under stress (Juhász, 2010). Driskell et al. (2006) suggested that the facets affecting teamwork are adjustment and self-esteem. The authors also commented that people with low adjustment scores are likely to be distressed, hostile, irritable, and nervous when issues or changes occur and tend to blame other team members for mistakes (Driskell et al., 2006). This type of behaviors can affect the confidence of the rest of the team members.

2.6 Openness to Experience

Openness to experience has been labeled as intellect, and it relates to individual characteristics such as imagination, curiosity, and creativity (Driskell et al., 2006; Goldberg, 1993; Juhász, 2010; O'Neill & Allen, 2010). O'Neill and Allen (2010) found openness to experience to have the highest score, since engineering projects require team members to be innovative and creative when finding solutions to a problem. Juhász (2010) suggested that openness to experience can also assist teams in developing skills necessary for decision-making and communication. Although Driskell et al. (2006) had initially suggested that openness-to-experience had little to do with teamwork, they later found that flexibility was relevant to team performance. Flexibility can affect an individual's ability to accept changes in tasks or construction methods (Driskell et al., 2006). The unwillingness to accept changes in a construction project can cause issues with the decision-making, which might be required in highly complex projects. The issue might even extend longer when dealing with uncertainty and risk, which tend to be high in complex projects.

The limitations of the reviewed studies were mainly regarding how the studies were conducted and the type of criteria used. Bradley, Klotz, and Postlethwaite (2012) studied conflict among team members due to decision-making and different perspectives (which were mainly personality differences). The results yielded positive feedback regarding how personality differences affect teamwork, but the study was conducted with undergraduate participants. Also, the authors did not consider project criteria and how different tasks might affect team members. In a construction project, the individuals tend to have more years of experience and are more mature, which could produce different results.

Thomas A. O'neill and Natalie and Allen (2001) conducted a very complex study using personality to predict team performance. They confirmed that conscientiousness predicted team performance, while opennessto-experiences had a small negative effect on team performance. However, their study did not consider a real construction process in which all principal stakeholders of the construction project were in constant interaction. They only included designers in which they competed for over six months, whereby personality traits (narrow and broad) and team performance were measured. This is another study in which team criteria and project criteria were considered.

This paper's objective is to determine which personality traits are best to use when forming a team for construction projects, based on team performance. The selection process that is going to be used in another paper will consist of personality scales criteria along with project and team criteria, and it should assist in selecting the best candidate. This paper will also consider which personality traits are most related to construction team performance to develop a personality test that is short and mostly related to what the construction industry needs from professional candidates. Later, the obtained personality traits are going to be utilized along with project and team criteria to create a selection process that yields effective teams.

2.7 Literature Review

Personality methods are tools for measuring personality traits, which results in assessment of one's personality. Personality is the assortment of characteristics that shape a person's character (Merriam-Webster.com, 2017), and the personality method is a process that seeks to describe and understand different characteristics of human behavior, their thoughts, perceptions, learning strategies, and emotions in different environments, such as personal and professional life (Sarason & Holzman, 1999). This variability distinguishes the personality characteristics known as traits (Sarason & Holzman, 1999). The focus point is ultimately the person, because they are carriers of the personality variability that researchers want to study (Carlson, 1971). Therefore, different personality characteristics become inferences from the observer interacting in environments where personality characteristics are elements of interaction (Sarason & Holzman, 1999). Carlson (1971), Sarason and Holzman (1999) had the same perspective regarding the variability in personality characteristics. They concluded that these variabilities are important factors in observing and understanding a person. It gives people a unique character or individuality, with which she or he interacts in any social event, personal or professional.

Measuring variability in personality characteristics should assist researchers or firms in assessing a candidate’s personality characteristics, such as the degree of creativity and problem-solving skills (Sarason & Holzman, 1999). The measurement can be used to understand the candidate’s capabilities and place her or him in a project wherein they can be aneffective team member. Sarason and Holzman (1999) give a good example of how different personality characteristics react depending on the environment the candidate is in and how this could be an asset or a liability;

> Personality makeup can be either an asset or a liability depending on the situation. For example, some people approach evaluative situations with fear and foreboding, while others seem to be motivated in a desirable direction by competitive pressures associated with performance.

The point the authors are making is that, depending on the personality characteristics of a person we should realize what makes the person fearful or enthusiastic. Knowing how the person feels about a work environment can make the difference when that person interacts with the rest of the team. The measuring method is as important as personality characteristics. There are many methods with many techniques to measure personality characteristics, making the selection of an adequate method a critical step (Sarason & Holzman, 1999). Therefore, a brief review of the history and the level of research conducted for the major personality methods will be explained.

The historical view of the diversity of personality research methods has gone through a rigorous process for many years by which different methods have used many data types and methodologies to encompass the personality characteristics and behaviors of humans (Craik, 1986). However, according to Craik (1986), there are two major aspects directing personality research methods: 1) Reformulation of concepts, and 2) Socio-cultural influences.

1) Theoretical concepts are linked to personality research method, which is based on two contemporary methodological events that have reformulated concepts such as motive and trait (Craik, 1986). Human motivation studies suffer a decline with the dereliction of the drive theory during the post-WWII period, which was replaced by analyzing human motivation in terms of goals and personal projects (Craik, 1986). With this change in concepts, detailed data collection (field studies and archival data) of everyday human interactions has increased (Craik, 1986). Trait refers to the individual behavior as a result of individual's internal characteristics, also known as dispositional constructs (Craik, 1986). The change in concept described by Craik (1986) means that traits are now observed as natural cognitive characteristics of a person's understanding through experience when researchers are describing behaviors of dissimilar interactions (Craik, 1986). Dissimilar interactions refer to the situation wherein a person behaves differently depending on the environment they are in, which also explains why a person could be either an asset or a liability depending on the situation. According to Craik (1986), motives and traits both monitor and analyze a person's daily behavior in different situations.

2) Socio-cultural paradigm has had a major impact on personality research method during the initial period of personality research (Craik, 1986). In the economic spectrum, personality research method was influenced by the hasty industrialization of the U.S. during the post-WWI period, which brought about many other issues, including anxiety and the estrangement due to a capitalist economy. This industrialization gave rise to new emotional distresses due to industry conflicts between employees and business leaders, which presented anopportunity to industrial psychologists to study personality characteristics in depth (Gibby & Zickar, 2008). The 1929 Great Depression caused emotional distress, playing a major role in personality research (Craik, 1986). The Great Depression prompted mass immigration between states as people were looking for a better life in other cities. The closure of businesses

during this period gave rise to mass immigration, includingmany adolescents (ushistory.org, 2017). Other social and cultural changes occurred due to the increasing rate of unemployment, crime, suicide, malnutrition, prostitution, uninsured Americans, alcoholism, and higher education dropouts (ushistory.org, 2017). Socio-cultural influences during the post-WWI period and the Great Depression of 1929 created the obsession to understand employees' emotions and problems , which became part of a new perspective of a societal trend towards cultural transformation, with emotional expression being in the focus (Gibby & Zickar, 2008; Goldberg, 1971). The main purpose of this paper is not to describe all major socio-cultural influences that shaped personality research, but, rather, toTable 2.1 offers anoverview of some major socio-cultural events that are directly correlated to the development of personality research method.

Table 2.1. Influence of Some Major Socio-Cultural Events

Sociocultural Event	**Year**	**Change or Method Developed**	**Influence**	**Source**
End of the Victorian Era	1901	Fear and anger have no positive functions and need to be avoided	Cultural shift in which emotions such as anger, fear, and guilt were thought useful for work and family	(Gibby & Zickar, 2008; Stearns, 1994)
World War I	1914-1918	Shell Shock	Military decided to commission a test to identify soldiers with emotional instability	(Gibby & Zickar, 2008; Goldberg, 1971; Woodworth, 1919)
The Great Depression	1929	Economic crises lead to the longitudinal personality research	Mass immigration (mostly adolescents), increased rate of unemployment, crime, suicide, malnutrition, prostitution, and higher education dropouts	(Stagner (1937, 1981); Craik (1986); and ushistory.org, 2017)
Post World War II	1939-1945	Bernreuter Personality Inventory	Transformation to a multi-method assessment (combination of different tests), starting a new era of personality testing	(Bernreuter, 1931); and Gibby and Zickar 2008)
Soviet Union Sputnik I (First artificial satellite)	1956	Link analysis of individual creativity to studies of organizational innovation (Identification and encouragement of creative persons)	Competitive technological and industrial burdens upon the U.S.	(Barron, 1969; Botkin, Dimancescu, & Stata, 1984; Craik, 1986; Guilford, 1950; MacKinnon, 1978; Staw, 1984)

Despite the social events that impacted the world and the United States, personality research methods, such as laboratory methods, observer judgments, personality and inventory, and projective techniques, continued developing into the modern personality scales (Craik, 1986). The method of interested in this paper has to do with the investigation conducted for personality scales and inventory. According to Craik (1986) and Goldberg (1971), the initial personality scales and inventory were a bi-product of different investigations between 1906 (Heymans & Wiersma's Symptom List) and 1917 (Woodworth's Personal Data Sheet (PDS) (Craik, 1986; Goldberg, 1971). According to Goldberg (1971), Woodworth's PDS was the beginning of the personality scales inventory, which resulted in over 116 scales. Approximately three years later, 116 scales that originated from Woodworth's study were adjusted to develop other personality scales and inventories, which are detailed in Table 2.2 (Goldberg, 1971). As many psychologists were interested in personality scales, more studies were conducted, leading to the refinement of the current personality scales and inventory. The first refinement was in 1936, with the creation of the Minnesota Multiphasic Personality Inventory (MMPI), which gave birth to 550 scales and contributed to the development of even more of them (Craik, 1986; Goldberg, 1971). For a better understanding of how these investigations impacted the personality scales and inventory, see Figure 2.1 for an approximate timeline, obtained from Goldberg (1971) and Craik (1986).

Table 2.2. Adjustments of Personality Scales after Woodworth's PDS

Date	Investigators	Reasons for Adjustment
1920 and 1923	Johnson, B.; and Mathews, E.	Adjustment scales and revisions of the PDS for children
1923	Cady, V. M.	Revision of the PDS for juvenile delinquents
1925, 1927, and 1930	Laird, D. A.; House, S. D.; and Thurstone & Thurstone	Revision of the PDS for adults
1933b	Bernreuter, R. G.	Creation of the four-scale personality inventory (Neurotic Tendencies Scale)
1919, 1920, and 1921	Pressey, S. L. & Pressey, L. W.; Pressey, S. L. & Chambers, O. R.; and Pressey, S. L.	Different methods applied to investigate differences in interests and emotional make-up. However, end results were an adjustment to scales
1930	Symonds, P. M.; & Jackson, C. E.	Adjustment Survey
1930	Jasper, H. H.	Depression-Elation Scale
1932	Willoughby, R. R.	Emotional Maturity Scale
1935	Washburne, J. N.	Social Adjustment Inventory
1943	Hathaway & McKinley	Creation of the MMPI first true refinement of personality scales and inventory

Due to the continuation of studies in personality scales and inventory, it is safe to say that personality scales and inventories have gone through a rigorous investigation and validation method. It supports the initial aim of this study, which is to use personality criteria as evaluators to determine the best candidates for a construction project. The social events mentioned in Table 2.1 assisted in the continuous development of personality scales and inventories, reaching maturity in the 1960s (Craik, 1986). Future social changes will continue to fuel and support the need to improve personality scales and inventories to serve society and the working force better. With globalization, there is a need to understand how cultural differences effect people's behavior at work. Therefore, it is important to implement a personality scale and inventory method that continues to improve its previous accomplishments. This also leads us to addressing some issues the construction industry is having with team building and integration of construction teams. Which personality scales are most adequate for selecting construction team members and how can they help the industry?

In Goldberg (1971), the vocational interests section states how personality inventories were popularized by the government, industrial industries, and education to distinguish individuals from their personality characteristics in events such as adjustment to social events, professional achievements, and contentment in working environment, as well as academic success. He mentions several inventories used to study different occupations, explaining how these occupations were affected by their achievements and failures. Goldberg (1971) also states that early inventories did not have the number of scales necessary to understand and measure vocational interests and that more scales with a higher level of complexity However, due to societal changes and the pressure to understand the human mind, personality inventories and facets will continue to be researched, which will improve the analysis of personality characteristics, as well as their effect on society and career (Goldberg, 1971).

As mentioned before, the idea to determine which employee is having issues at work or who is not performing efficiently resulted from major social changes, such as WWI and WWII, and the Great Depression. These events, among others, have affected behavior, resulting in the creation of personality tests that quantify the level of emotions affecting the worker (Gibby & Zickar, 2008). Originally, personality tests were used to determine which person was emotionally unfit to perform a specific work. The government used tests such as the Shell-Shock to determine which soldiers were emotionally unfit for military duty (Gibby & Zickar, 2008). The same concept was used by the industry to predetermine which employees should be selected by focusing on the negative aspects of personality, such as adjustment and maladjustment (Gibby & Zickar, 2008). However, as personality scales and inventories continued to improve, the focus was shifted on more positive aspects of personality. Therefore, psychologists have created the following personality scales, which are used by many firms 1) Adjective Check List, 2) Big Five Personality Traits, 3) California Psychological Inventory (CPI), 4) Five Factor Model (FFM), 5) Goldberg Five Factor Markers, 6) Goldberg International Personality Item Pool, 7) Myers Briggs Type Indicator, and 8) Neo Personality Inventory. This research is interested in the Big Five Factor personality scales and inventory, since is common in personality assessment. The remaining personality methods will be used as references, to compare their facets for validity purposes.

2.8 The Big Five Personality Traits

Between 1958 and 1961, personality scales and inventories were reborn, with many psychologistsgrouping personality scales into the Big Five personality traits (Gibby & Zickar, 2008; Goldberg, 1993). As a result, the Big Five Factors (BFF) was created and clustered into the following five factors: 1) EX, 2) AG, 3) CO, 4) NE, and 5) OP (Goldberg, 1993b). Table 2.4 describes the factors, and Table 2.3 details the facets for each factor. What made the BFF so popular around the world? According to Goldberg (1990) and Soldz and Vaillant (1999), the BFF was accepted because the findings of several studies had shown that the same five-factors structure can be seen in other personality methods, such as the ACL method and many others (Soldz & Vaillant, 1999). Another important element that assisted in the acceptance of the BFF was that personality characteristics found in self-reported trait testing could also be found in personality testing when performed on participants who know the person being evaluated (Soldz & Vaillant, 1999).

Table 2.3. Description of the Big Five Factors

Factors	Description
1. Extraversion	The ability of a person to engage with the external world. The opposite is introversion.
2. Agreeableness	Demonstrates how people differ regarding cooperation and social harmony. The opposite is disagreeableness.
3. Conscientiousness	The ability of a person to control, regulate, organize, and direct emotions or impulses. The opposite is easy going, disorderly, and no self-control.
4. Neuroticism	Describes how a person experiences negative feelings. The opposite is being emotionally stable.
5. Openness to Experience	Describes and distinguishes people's level of creativity and intellectual awareness. The opposite is not accepting change, being traditional, like familiar routines, and narrower choice of interests.

Table 2.4. Facets for Each Factor

Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness to Experience
1. Friendliness 2. Gregariousness 3. Assertiveness 4. Activity 5. Excitement-Seeking 6. Cheerfulness	1. Trust 2. Compliance/ Morality 3. Altruism 4. Cooperation 5. Modesty 6. Sympathy	1. Competence 2. Orderliness 3. Dutifulness 4. Achievement-Striving 5. Self-Discipline 6. Cautiousness	1. Anxiety 2. Angry Hostility 3. Depression 4. Self-Consciousness 5. Immoderation 6. Vulnerability	1. Fantasy/Imagination 2. Aesthetics 3. Feelings 4. Adventurousness 5. Ideas/Intellect 6. Liberalism

How important are personality characteristics as criteria for measuring performance and collaboration? According to Goldberg (1993), finding a correlation between personality characteristics and job performance is critical in assisting the recruitment of employees (Goldberg, 1993). It is clear that behavior has a substantial effect on job performance, especially when people's personality characteristics conflict with job performance criteria or team criteria (Goldberg, 1993). Goldberg concluded that analysis, procedures, and reliable measurements need to be performed to match personality with job criteria and team criteria (Goldberg, 1993). Therefore, a literature review on team building and personality traits was conducted to find what facets are linked to job performance, team building, and collaboration.

2.9 Meta-Analysis Methodology

With abundant research regarding personality traits, it is crucial to review some of these personality studies to see how useful personality can be as a team selection tool. Professionals' behavior is the result of various events that have shaped their character . These behaviors are manifested in the social environment, and they coexist as interactions of personal and professional opinions or beliefs. Social interactions, have been the most interesting for many researchers, trying tounderstand why people behave differently, which could assist in predicting who is successful or not. In the construction industry, there is plenty of technology and funds to complete a project. However, there is a need to determine a better way of selecting team members to increase project's success.

This study selected meta-analysis methodology, as it offers an opportunity to investigate previous studies by statistical integration of evidence collected from the selected studies (Quintana, 2015). The meta-analysis procedure compares the studies and tests, by utilizing the correlation coefficient measures (Cooper, 2016). It is crucial, however, that studies share a common measurement that can be tested for the studied relationship (Cooper, 2016). The guideline used in this paper to conduct meta-analysis is derived from the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA), which specifies the objective of conducting meta-analysis (Moher, Liberati, Tetzlaff, & Altman, 2009). The PRISMA guideline was adopted because it helps adopt a systematic approach to conducting a study, while capturing necessary data from previous investigations.

The meta-analysis should ensure that necessary statistical methods are used to analyze and summarize the studies relevant to determining which personality traits are correlated to team building and project team performance. Therefore, the main objective of this meta-analysis is to summarize, appraise, and analyze (Cooper, 2016) traits that relate to team performance and to answer two questions:

Q1: What personality traits can influence team performance on construction projects?

Q2: How do personality traits influence team performance on construction projects?

Therefore, the hypothesis of this study is:

H1: The selected studies from the literature review will demonstrate that personality traits are consistently related and there is no difference between the mean effect sizes when conducting a meta-analysis with C.I. at 95%.

2.10 Collecting the Studies

The meta-analysis will include studies on the relation between team building/team performance and personality traits. The electronic databases used were Science Direct, American Society of Civil Engineers library (ASCE Library), the Transportation Research Board's (TRB) Transportation Research Record (TRR), PubMed, PsycINFO, Psychological & Behavioral Science Collection (PBSC), Business Source Complete (BSC), MEDLINE, PsycARTICLES, and JSTOR Journals. The keywords were used in a combination style to find the studies. The keywords of "personality", "personality traits", and "personality behaviors" were interconnected to "team", "teambuilding", "team performance", "construction projects", and "construction team." To ensure the right studies were collected and to avoid unrelated studies, the keywords were searched in the title, abstract, keywords, and between 1990 and 2017. See Table 2.5 for a detailed view of how the keywords were used.

Table 2.5. Results of Articles from Databases

Database	Keywords Combinations	Total Articles
ASCE	"personality traits" and "team performance"	2
ScienceDirect	(Personality traits) and ("construction team" OR teambuilding OR team performance) AND LIMIT-TO (topics, "personality trait, behavioral science, and team")	67
TRB	personality behavior and (team OR "team performance" OR teamwork OR "team efficiency")	2
PubMed	Personality traits and (team)	33
PsycINFO	personality behavior and (team OR "team performance" OR teamwork OR "team efficiency")	158

Table 2.5 Continued.

Database	Keywords Combinations	Total Articles
PBSC	personality behavior and (team OR "team performance" OR teamwork OR "team efficiency")	104
BSC	personality behavior and (team OR "team performance" OR teamwork OR "team efficiency")	39
MEDLINE	personality behavior and (team OR "team performance" OR teamwork OR "team efficiency")	9
PsycARTICLES	personality behavior and (team OR "team performance" OR teamwork OR "team efficiency")	6
JSTOR	personality behavior and (team OR "team performance" OR teamwork OR "team efficiency")	5

2.11 Inclusion of the Selected Studies

Once collected, the studies had to be evaluated to confirm their relativeness to this paper’s objective. To include found the studies, they had to meet the following inclusion criteria:

- Published materials include peer-reviewed journals, conference papers, and dissertations.
- The subject in the meta-analysis consists of teams in the following industries: 1) construction, 2) business/corporations, 3) military, and 4) educational institutions. Preferably, the research focused on studies conducted in the construction industry. However, not many personality traits with correlation to team performance studies are expected to be found in the literature. Therefore, the meta-analysis was expanded to include other industries to understand personality traits influence on team’s performance.
- The meta-analysis only includes papers published in the English language.
- The intervention of the meta-analysis reviews studies evaluating traits correlated to team building and team performance.
- The meta-analysis includes studies published between January 1990 and January 2017.
- This meta-analysis includes publications from North America, Europe, and Asia.

- The studies have to report estimates either in the form or *r* or *d* with corresponding sample size *n* for teams or individuals.
- The quality of the study will be determined by evaluating the conclusion of the results:
  - Provides the results.
  - Explanation of the results utilizing the actual figures that either provided significant or non-significant effect.
  - Provides an explanation of the limitations.

The original results from the research of articles were 425 articles that were possibly related. After evaluating the abstracts and relation to team building/ team performance of each paper, the total articles that were related was 72. The 72 articles passed on to the inclusion criteria process resulted in 36 studies that met the criteria to be included in the meta-analysis procedure. It was also determined that 36 articles did not meet the inclusion criteria.

A study flowchart was created to demonstrate how the studies' selection process was conducted after the studies had been identified, which is detailed in Figure 2.1.

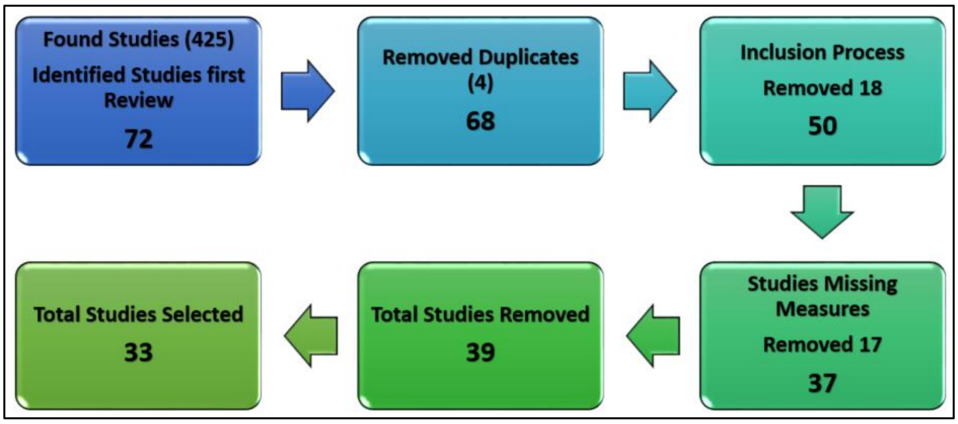

Figure 2.1. Study Selection Flow Chart (Adapted from Kayis et al., 2016)

2.12 Coding Process

The coding for the meta-analysis consists of enumerating the studies to simplify the sources and the authors. This will assist the principal researcher (PI) in creating a manageable database that has the necessary information in a single area (Cooper, 2016; Ellis, 2010). The table collecting the information from the studies includes the following (See Table 2.6 to view selected studies):

- Study: $k = 1, 2, 3,\ldots,n$
- Year: Published year
- Subject: Construction = 1, Business = 2, Engineering = 3, Students = 4, Military = 5, and None = 0
- Personality Method implemented (PM)
- Location: North America = L1, Europe = L2, and Asia = L3
- Estimate: Pearson product-moment correlation coefficient *r* will be used. If *r* is not provided and Cohen's *d* is, then a conversion formula provided by Ellis (2010). will be applied Cohen's d is defined as the difference between two estimate means divided by the standard deviation.
- Team Sample Size: N_t will be used for team sampled size from N individuals
- Total Sample: *N* will be used for total sampled population of all individuals
- Personality Traits: Extraversion (EX), Agreeableness (AG), Conscientiousness (CO), Neuroticism (NE), and Open to Experience (OP)

Table 2.6. Selected Studies

Study	**Year**	**Subject**	**PM**	**Location**	**N**	**N-Teams**	**EX (r)**	**AG (r)**	**CO (r)**	**NE (r)**	**OP (r)**
1	2010	Engineering	NEO-PI	L2	90	17	0.2214	0.2500**	0.2665	0.0500**	0.1600**
2	2010	Students	IPIP	L1	129	26	0.0200	0.0100	0.2700	-0.0500	-0.1600
3	2003	Students	NEO-PI	L1	267	59	0.3000	0.0600	0.2700	-0.0800	0.2100
4	2013	Students	IPIP	L1	178	27	0.1200**	0.2900	0.3667	0.0500**	0.1600**
5	2013	Students	IPIP	L1	562	117	0.1200**	0.2500**	0.2400**	0.2236	0.2646
6	2015	Students	IPIP-NEO	L2	37	11	0.0981	0.3411	0.2914	0.1860	0.1280
7	2004	Students	MBTI	L1	193	7	0.2420	-0.0120	0.1710	0.0500**	0.1370
8	2013	Students	FFM	L1	121	5	0.5330	-0.2150	0.2400**	-0.2290	0.1600**
9	2012	Business	BFQ	L2	101	*	0.3400	0.3450	0.4300	0.3600	0.1600**
10	2008	Military	NEO-FFI	L1	472	39	0.3400	-0.0500	0.3000	0.1800	0.2800
11	2014	Students	NEO-FFI	L1	184	46	0.3000	-0.0300	-0.1400	0.0500**	0.1600**
12	2006	Students	NEO-FFI	L1	312	78	0.0188	-0.0400	-0.0475	-0.1300	0.1725
13	2005	Business	PCI	L1	90	*	0.2100	0.1800	0.2100	0.1700	0.1600**
14	2003	Students	NEO-PI-R	L1	219	73	0.1533	-0.1533	0.3667	0.0500**	0.2333

Table 2.6 Continued.

Study	Year	Subject	PM	Location	N	N-Teams	EX (r)	AG (r)	CO (r)	NE (r)	OP (r)
15	2009	Business	WBI	L1	261	*	0.2000	0.0350	0.1550	0.1750	0.1550
16	1999	Business	PA-CPI	L1	328	82	0.0900	0.1800	0.1700	0.0800	0.1000
17	2011	Business	NEO-PI-R	L1	252	31	0.1750	0.3550	0.2400	0.0550	0.3650
18	2003	Students	FFM	L1	284	71	0.1700	0.1200	0.1900	-0.2300	0.1600**
19	2014	Business	NEO-FFI	L1	1061	102	0.4500	0.3800	0.2400**	0.0500**	0.1600**
20	1997	Students	FFI	L1	289	61	-0.1200	-0.0500	-0.0900	-0.0800	-0.1000
21	2008	Students	FFPI	L2	128	26	0.1200**	-0.1500	0.3400	0.0500**	0.1600**
22	2000	Students	GACL	L1	320	67	-0.2100	0.2500**	0.3000	0.0500**	0.0200
23	2005	Military	NEO-FFI	L1	422	47	0.1200**	0.2800	0.3400	0.0500**	0.1600**
24	2017	Business	BFI	L3	338	71	0.2000	0.2600	0.2460	-0.0540	0.1840
25	2011	Students	IPIP	L1	434	114	0.1200**	0.1800	0.2300	0.0500**	0.1600**
26	2017	Students	FFI	L1	768	239	-0.0600	0.2500**	0.1000	-0.0500	0.1600**
27	1998	Business	PCI	MIX	652	51	0.1200	0.3400	0.2600	0.2400	0.1600**
28	2012	Students	IPIP	MIX	644	209	0.1200**	0.2500**	0.0850	0.0500**	0.1600**
29	2007	Engineering	NEO	L1	230	*	0.1200**	0.2300	0.3400	0.0500**	0.1600**
30	1997	Students	SAPPS	L3	102	17	0.2600	0.2500**	0.2400**	0.2700	-0.2800
31	1999	Business	NEO-PI-R	L1	316	79	0.0600	0.3600	0.2700	-0.1200	-0.0100
32	2015	Business	BFI-10	L3	562	79	0.5200	-0.1300	0.2700	-0.1600	0.0500
33	2016	Business	BFPT	L3	150	*	0.5040	0.5940	0.5460	-0.1130	0.4990
(*) = Team sample size was not provided; (**) = Missing value replaced with Bell (2007) meta-analysis											

Conversion formula from Cohen's *d* to *r*:

$$\sqrt{\frac{d^2}{4+d^2}} \tag{1}$$

From the original literature research , there 425 studies that fitted the keywords utilized to perform the research were found. However, after reviewing the abstracts and results, there were 72 studies related to personality traits and team performance. One study was removed because it was considered duplicate Bell (2007). However, her meta-analysis was utilized to fill in some missing values. The inclusion process removed 18 studies because different personality traits, unrelated to the Big Five Factor, were used, or the studies were summaries, or they did not include personality traits but rather other behaviors. Finally, 17 studies were removed due to missing measurements for the personality traits being studied. No studies were removed due to only reporting two personality trait measurements. These studies were included in the meta-analysis and dealt with differently, which is discussed next.

As expected, some studies did not report correlation values for all personality traits. Three options were available to deal with the missing values, but only one was selected as the best fit. The first option was to ignore the missing value and proceed with the studies that reported measurement for all five personality traits. However, this option would have resulted in a lower count of studies in the meta-analysis. The second option was to treat the missing data as zero. This could have been a good option, but it could also change the standard error of the studies. The third option was to find a meta-analysis related to this study and utilizing the overall estimate as fillers for the missing data, which was considered as the best choice for the missing values. The meta-analysis conducted by Bell (2007) "Deep-Level Composition Variables as Predictors of Team Performance: A Meta-Analysis" was selected as an adequate study to fill in the missing values. Her meta-analysis was adequate because of incorporated field-setting teams, which resemble construction teams. Bell (2007) overall correlations for field type setting teams are as follows: EX r = 0.12, AG r = 0.25, CO r = 0.24, NE r = 0.05, and OP r = 0.16. Table 2.6 above illustrates the imputed values. There were also six studies (study 9, 13, 15, 17, 29, and 33) that did not report the team size sample, although they reported the individual sample size. To deal with the missing team size values for these studies, it was decided that construction teams have a minimum of five team members on a project representing the principal stakeholder, which are: the owner, designer, prime contractor, consultant, and utility. Therefore, the individual sample size was divided by five to obtain a team size sample. The imputed values are illustrated in Table 2.6 with asterisks (*) = Team sample size was not provided; (**) = Missing value replaced with Bell (2007), and appendix I is the list of the sources for the 33 studies selected.

2.13 Calculating Mean Effect Size

According to Cooper (2016) and Ellis (2010), the effect size is defined as "the degree to which a phenomenon is present in the population." The effect size should assist in determining if differences between the studies are real . Therefore, for this study, it is expected that there will be no variation between the mean effect sizes of the selected studies.

The statistical calculations to be completed for this study will utilize the Metafor procedure for conducting a meta-analysis in R (R Development Core Team, 2017; Viechtbauer, 2010) written by Viechtbauer (2010). The Comprehensive R Archive Network, also known as CRAN, is an open-source software available to researchers to conduct statistical analysis procedures https://cran.r-project.org/web/packages/metafor/index.html. The study will also utilize the script for meta-analysis written by Quintana (2015), who provided the script for R in the following website: https://github.com/dsquintana/corr_meta. Quintana (2015) utilizes the Metafor created by Viechtbauer (2010), along with "robumeta" created by Fisher and Tipton (2015). The robumeta used for this research was updated to version 2.0 on May 29th, 2017. Quintana (2015) stated that he provided the script in R to assist other researchers in conducting meta-analysis and also to encourage others to perform more meta-analyses.

The R software consists of elaborate formulas and procedures for conducting the meta-analysis for fixed and random methods. For more details on how the formulas are used and implemented in R, the reader should review the following books and papers suggested by Quintana (2015), Viechtbauer (2010), Cooper (2016), and Ellis (2010).

2.14 Calculating Mean Effect Size

Ellis (2010) provides a simple explanation on how to calculate mean effect size of the studies collected using the effect size estimate of correlation coefficient *r* (Pearson's r statistic). According to Ellis (2010), it is better to calculate the weighted mean effect ($\bar{r}_w$) of each study by their respective sample size. Calculating a simple mean on the estimates of the selected studies will most likely be a bias result. Therefore, weighting the selected estimates is an enhanced way to place more weight on those selected studies that have larger sample sizes. The formula to calculate ($\bar{r}_w$) is as follows:

$$(\bar{r}_w) = \frac{\sum r_i * n_i}{\sum n_i} \qquad \text{Equation (2)}$$

Where, r_i is the estimate measure of each selected study, n_i is the sample size of each study, and $\sum n_i$ is the sum of all selected sample size studies or N. If the error *(α_1)* is provided in the studies, a much better weighted mean effect size can be obtained by the following formula:

$$(\bar{r}_{w\alpha}) = \frac{\sum \frac{r_i}{\sqrt{\alpha}} * n_i}{\sum n_i} \qquad \text{Equation (3)}$$

2.15 Computing Statistical Significance of the Mean

Since the studies are not conducted with the same sample size and have distinct characteristics and methods of analysis, Cooper (2016), Ellis (2010), Quintana (2015), and Viechtbauer (2010) recommend the random-effects model, because it provides less weight to studies with larger sample sizes and less variance. According to Quintana (2015), the confidence interval (CI) is much wider than the fixed-effects model.

Statistical significance in this study will be done by converting the results into z-scores and determining if the probability of getting a z-score is less than alpha (α) at 0.05 (Cooper, 2016; Ellis, 2010; Quintana, 2015; Viechtbauer, 2010). The CI 95% is then used to verify if the null hypothesis of zero is in the CI range (Ellis, 2010). To obtain the z-score, the standard error (SE) has to be determined for the related mean effect size of the selected studies. Sampling distribution has certain spread or variability, and SE assists in explaining what that value might be. Since SE is the square root of the variance, the variance of the sample of correlation (v_r) has to be determined (Ellis, 2010). Ellis (2010) provides a formula as follows:

$$(v_r) = \frac{\sum \left(\left(\frac{r_i}{\sqrt{\alpha}} \right) - \bar{r}_w \right)^2 * n_i}{\sum n_i} \qquad \text{Equation (4)}$$

Therefore, the SE of the weighted estimate (SE.$\bar{r}_w$) is as follows:

$$SE.\bar{r}_w = \sqrt{\frac{v_r}{k}} \qquad \text{Equation (5)}$$

Where k is the total number of studies in the meta-analysis. The SE.$\bar{r}_w$ will assist in converting mean correlation into z-score, which conveys the deviation scale of the effect mean estimate from all the selected studies (Ellis, 2010). The conversion from r-score to z-score is as follows:

$$z = \frac{|\bar{r}_w|}{SE.\bar{r}_w} \qquad \text{Equation (6)}$$

The results will be compared to the selected significant value ($\alpha = 0.05$) for a two-tailed test. Any z-scores above 1.96 will result in rejecting the null hypothesis, concluding that there are significant differences between the coefficient r estimates of the selected studies (Ellis, 2010). The 95% CI will be used to verify the results with significance at 0.05 (p-value < 0.05). the formulas for 95% CI are as follows (Ellis, 2010):

$$\bar{r}_{w\alpha} \pm \left(z_{(\frac{\alpha}{2})} * SE.\bar{r}_w\right)$$

$$Lower\ Limit = \bar{r}_{w\alpha} - \left(z_{(\frac{\alpha}{2})} * SE.\bar{r}_w\right) \qquad \text{Equation (7)}$$

$$Upper\ Limit = \bar{r}_{w\alpha} + \left(z_{(\frac{\alpha}{2})} * SE.\bar{r}_w\right)$$

If the null hypothesis is not within the CI, the r estimates of the selected studies are different, thus rejecting the null hypothesis.

2.16 Examining Variability

To examine if the selected studies are heterogeneous, the Q statistic, and the I^2 test are recommended by Quintana (2015), Viechtbauer (2010), Cooper (2016), and Ellis (2010). A wide CI indicates that the distribution of the effects' sizes is not centered on a single population mean but spread among several population means. The Q-statistic test should give a clear picture of the differences between the selected studies in the meta-analysis (Ellis, 2010). The Chi-square is used to interpret the findings for k – 1 degrees of freedom (df), where k = the number of studies selected). If the Q statistic is larger than the Chi-square value for k -1 df, the null hypothesis would be rejected, indicating the study estimates are heterogeneous (Cooper, 2016; Ellis, 2010; Quintana, 2015; Viechtbauer, 2010). The Q statistic is calculated as follows:

$$Q = \sum (n_i - 1) * (r_i - \bar{r}_w)^2 \qquad \text{Equation (8)}$$

Where n_i is the sample size of the corresponding selected studies r_i, and the weighted mean effect size estimate $\bar{r}_w$.

Heterogeneity helps in quantifying the inconsistency of the mean effect size among all the selected studies in the meta-analysis. However, the Q statistic might not perceive variability with a small number of studies selected. Therefore, the I^2 test will be included in this paper to reaffirm the findings of the Q statistic. The I^2 test calculates variance as a percentage due to heterogeneity among the selected studies and not the sampling error (Theofilatos, Ziakopoulos, Papadimitriou, Yannis, & Diamandouros, 2017). The I^2 test uses the following equation:

$$I^2 = \sum (n_i - 1) * (r_i - \bar{r}_w)^2 \qquad \text{Equation (9)}$$

2.17 Publication Bias

According to Quintana (2015), publication bias occurs when studies with stronger effect sizes are included in the meta-analysis procedure. Quintana (2015) suggests using the funnel plot to visually determine potential publication bias. The funnel plot uses the effect size correlation coefficient (r) on the x-axis and the SE on the y-axis. According to Cooper (2016), studies with a small sample size will be scattered at the bottom of the plot, while studies with a larger sample size will be close together at the top, which indicates precision. Therefore, if the funnel plot illustrates a symmetrical plot (studies equally distributed on both sides of the centerline), there are no signs of publication bias (Quintana, 2015). The R software will create the necessary funnel plot for review, which is reported in the results section.

Finally, since the Funnel Plot is a visual illustration of publication bias, it can be subjective. To be more assertive with the results, a rank correlation test using Kendall's Tau and Regression test through RStudio was used to test for funnel plot asymmetry at alpha 0.05. Any p-value greater than 0.05 signifies that there is no publication bias (Quintana, 2015).

2.18 Results

The literature review revealed that 33 studies fitting the inclusion criteria described the correlation between personality traits and team performance, and are presented in Table 2.6. The mean team sample size ranges from 5 to 239, with a median team size of 47, a mean of 56, a standard deviation of 55.54, and a total of 1,851 teams. The literature review reported a total of 44 correlations that had to be imputed for missing values with a total of 121 correlations: extraversion consisted of 26 (21.5%) correlations and 7 missing correlations; agreeableness consisted of 27 (22.3%) correlations and 6 missing correlations; conscientiousness consisted of 29 (23.9%) correlations and 4 missing correlations; neuroticism consisted of 21 (17.4%) correlations and 12 missing correlations; open to experience consisted of 18 (14.9%) correlations and 15 missing correlation. Conscientiousness had the highest percentage of actual correlations, and open to experience had the lowest actual correlations, which is expected, since all investigations suggest conscientiousness as a good estimator for team performance.

See Table 2.7 for descriptive statistics for each personality trait. To get meaningful results, statistical analysis was conducted for each personality trait, considering team sample, individual sample, subject, and personality method used. The presentation of the results is given in the following section. Tables 10, 11, 12, and 13 detail the meta-analysis for all personality traits.

Table 2.7. Descriptive Statistics for Each Personality Traits

Description	EX (r)	AG (r)	CO (r)	NE (r)	OP (r)
Mean	0.1811	0.1579	0.2335	0.0377	0.1409
Standard Error	0.0295	0.0333	0.0239	0.0243	0.0240
Standard Deviation	0.1697	0.1914	0.1375	0.1397	0.1379
Sample Variance	0.0288	0.0366	0.0189	0.0195	0.0190
Kurtosis	0.4751	-0.5225	1.9321	-0.1048	3.3163
Skewness	0.2268	-0.1872	-0.8633	0.1045	-0.7446
Range	0.743	0.809	0.686	0.59	0.779
Minimum	-0.21	-0.215	-0.14	-0.23	-0.28

Table 2.7 Continued

Description	EX (r)	AG (r)	CO (r)	NE (r)	OP (r)
Maximum	0.533	0.594	0.546	0.36	0.499
Sum	5.9756	5.2098	7.7068	1.2436	4.6484
Count (k)	33	33	33	33	33
Missing Values	7	6	4	12	15
Confidence Level (95.0%)	0.0602	0.0679	0.0488	0.0496	0.0489

Table 2.8. Random-Effects Model of Personality Traits (k = 33)

	Random Effect Model (k= 33)						
	Personality Trait	**Tau^2**	**Tau**	**I^2**	**H^2**	**Q**	**Q p-value**
Teams	**EX**	0.018	0.133	50.21%	2.01	61.31	0.0014*
	AG	0.015	0.121	45.41%	1.83	54.40	0.0080*
	CO	0.004	0.065	19.37%	1.24	35.02	0.3268
	NE	0.001	0.034	6.13%	1.07	27.63	0.6877
	OP	0.000	0.000	0.00%	1.00	21.70	0.9152
Individuals	**EX**	0.0300	0.1740	90.41%	10.43	401.63	< 0.0001*
	AG	0.0350	0.1870	91.60%	11.90	351.73	< 0.0001*
	CO	0.0160	0.1280	83.61%	6.10	164.85	< 0.0001*
	NE	0.0140	0.1200	81.62%	5.44	172.04	< 0.0001*
	OP	0.0130	0.1140	80.16%	5.04	126.58	< 0.0001*

Note: (*) = Significant if < 0.05

Table 2.9. Mean Estimate Model Results of Personality Traits (k = 33)

Model Results of Personality Traits							
Personality Trait		**Estimate**	**SE**	**z-value**	**p-value**	**CI-LB**	**CI-UN**
Teams	**EX**	0.1633	0.0353	4.6291	< 0.0001*	0.0945	0.2325
	AG	0.1735	0.0336	5.1595	< 0.0001*	0.1076	0.2394
	CO	0.2111	0.0268	7.8627	0.3268	0.1585	0.2637
	NE	0.0197	0.0241	0.8176	0.4136	-0.0275	0.0669
	OP	0.1508	0.0228	6.6046	< 0.0001*	0.1061	0.1956
Individuals	**EX**	0.1876	0.0327	5.7355	< 0.0001*	0.1235	0.2517
	AG	0.164	0.0349	4.7046	< 0.0001*	0.0957	0.2323
	CO	0.2366	0.0253	9.3564	< 0.0001*	0.1870	0.2862
	NE	0.0329	0.0239	1.3748	0.1692	-0.0140	0.0798
	OP	0.1477	0.0231	6.3987	< 0.0001*	0.1025	0.1929

Note: (*) = Significant if < 0.05

Table 2.10. Mean Estimate Transformation Fisher’s z to Pearson’s r (k = 33)

Transformation Fisher’s z to Pearson’s r						
Personality Trait		**Estimate**	**CI-LB**	**CI-UN**	**r-CI-LB**	**r-CI-UB**
Teams	**EX**	0.162	0.094	0.228	-0.107	0.408
	AG	0.172	0.107	0.235	-0.073	0.397
	CO	0.208	0.157	0.258	0.073	0.336
	NE	0.020	-0.028	0.067	-0.062	0.101
	OP	0.150	0.106	0.193	0.106	0.193
Individuals	**EX**	0.185	0.123	0.247	-0.159	0.489
	AG	0.163	0.095	0.228	-0.207	0.491
	CO	0.232	0.185	0.279	-0.020	0.456
	NE	0.033	-0.014	0.080	-0.203	0.266
	OP	0.147	0.102	0.191	-0.080	0.359

Note: (*) = Significant if < 0.05

Table 2.11. Publication Bias for Personality Traits Team/Individual Sample Size (k = 33)

Asymmetric Funnel Test Significant at < 0.05										
Bias Test Estimates	**Personality Trait**									
	EX		**AG**		**CO**		**NE**		**OP**	
	Teams	**Indiv.**	**Teams**	**Indiv.**	**Teams**	**Indiv.**	**Teams**	**Indiv.**	**Teams**	**Indiv.**
Reg.Test z-score	1.1300	0.5779	-0.2095	-0.0462	2.0064	1.2771	0.9061	0.8453	-0.2808	-0.7383
Reg.Test p-value	0.2585	0.5633	0.8341	0.9632	0.0448*	0.2016	0.3649	0.3979	0.7788	0.4603
Kendall’s tau	0.2493	0.2011	-0.0895	-0.1556	0.0629	0.0417	0.021	-0.0721	-0.2724	-0.2735
Kendall’s p-value	0.0423*	0.1004	0.4661	0.2038	0.6089	0.7331	0.8646	0.5559	0.0266*	0.0256
Egger Test t-score	1.5347				2.1855				-0.3363	-0.6231
Egger Test p-value	0.135				0.0365*				0.7389	0.5378

2.19 Extraversion

2.19.1 Statistical Significance of the Mean Effect Size

The estimated model of the mean effect size for extraversion trait was statistically significant with a p-value of < 0.0001 for both team and individual sample size. To further validate the result, zero is not included in both CI, as seen above in Table 2.9. For extraversion, it can be concluded that correlations are not the same across the 33 studies selected for the meta-analysis. This could also mean that extraversion is very diverse in the population, or that there are many team members with different levels of extraversion. It was also observed that the effect size between team and individual sample indicates that there is a positive relationship. However, the relationship is stronger when evaluating team members’ personality traits individually than as a team average . The effect size for team is r0.162, and the effect size as individual is r0.185. There is a possibility that extraversion in a team is better evaluated per team member than averaging the score of all team members.

2.19.2 Examining Variability

It can be observed that mean estimated correlation for extraversion has a Q-Statistic of 61.31 for team sample, and 401.63 for individual sample. Both Q-Statistic measures were significant, as shown in Table 2.8. Chi-Square value for df = 33 alpha 0.05 is 47.4; therefore, the null hypothesis is rejected for both team and individual samples, indicating the coefficient correlations of the selected studies for extraversion are heterogeneous.

The I^2 indicates that there is 50.21% (team) and 90.41% (individuals) of variation due to heterogeneity, reflected in the actual differences in the selected studies mean effect correlation. This implies that extraversion among the studies does not share a common effect size. Testing for heterogeneity (d.f. 32), the p-values are 0.0014 (team) and <0.0001 (individual), which further validates that the mean effect size is not homogeneous. The I^2 for individual sample proves to be even more significant with a 90.41% variation, and heterogeneity testing of < 0.0001. This indicates that variation is higher when measuring team members individually than as a team.

A Baujat Plot was created to illustrate which studies are contributing to the overall heterogeneity for extraversion. Studies that are in the top right quadrant contribute more to the heterogeneity of extraversion. The studies that have a more common effect size are placed on the bottom left of the graph, which can also be observed in the forest plot detailed in Figures 2.2 and 2.3. The forest is a graphical representation of the mean effect size calculated from the selected studies, which are represented by a diamond. The width of the diamond represents the 95% CI of the mean effect size, and studies with larger squares contribute more to the summary effect size. Studies that are within the range of the diamond are the studies that have contributed to the mean effect size of the meta-analysis. For the team sample, studies 19 and 32 (see Figure 2.4) contribute more to the heterogeneity of extraversion. These studies could also be considered outliers, as they have either very low or high correlation estimates (further from 0). For the individual sample, studies 33, 8, 22, and 32 (see Figure 2.5) contribute more to the heterogeneity of extraversion, which has more studies contributing to the heterogeneity estimate.

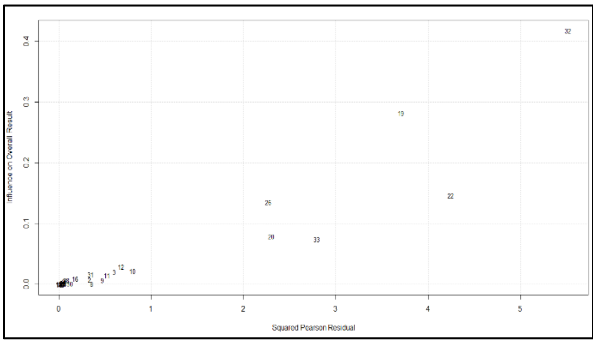

Figure 2.2. Extraversion Baujat Plot for Team Sample

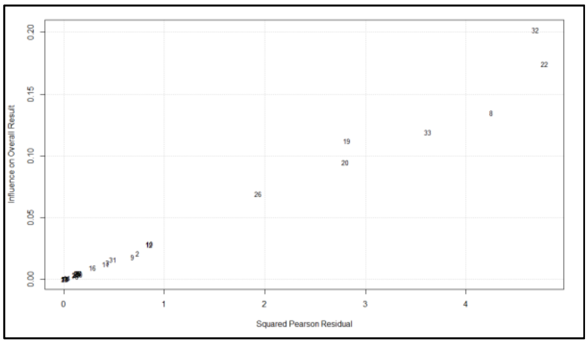

Figure 2.3. Extraversion Baujat Plot Individual Sample

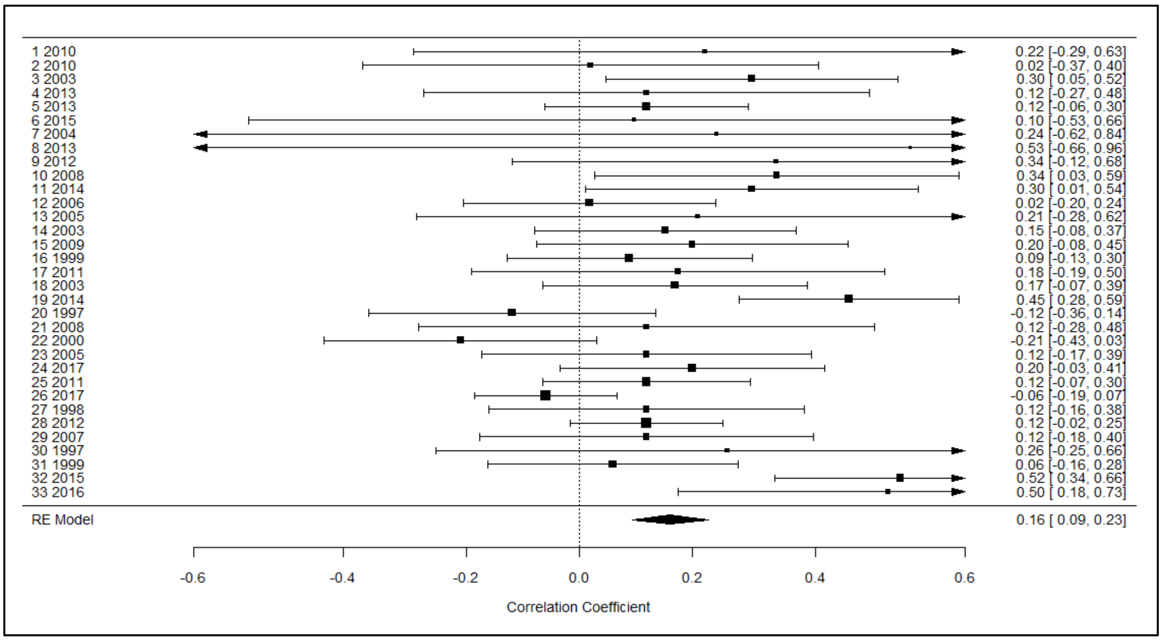

Figure 2.4. Extraversion Forest Plot Correlation Coefficient (Team Sample). A good illustration of the studies that contributed to the mean observed correlation

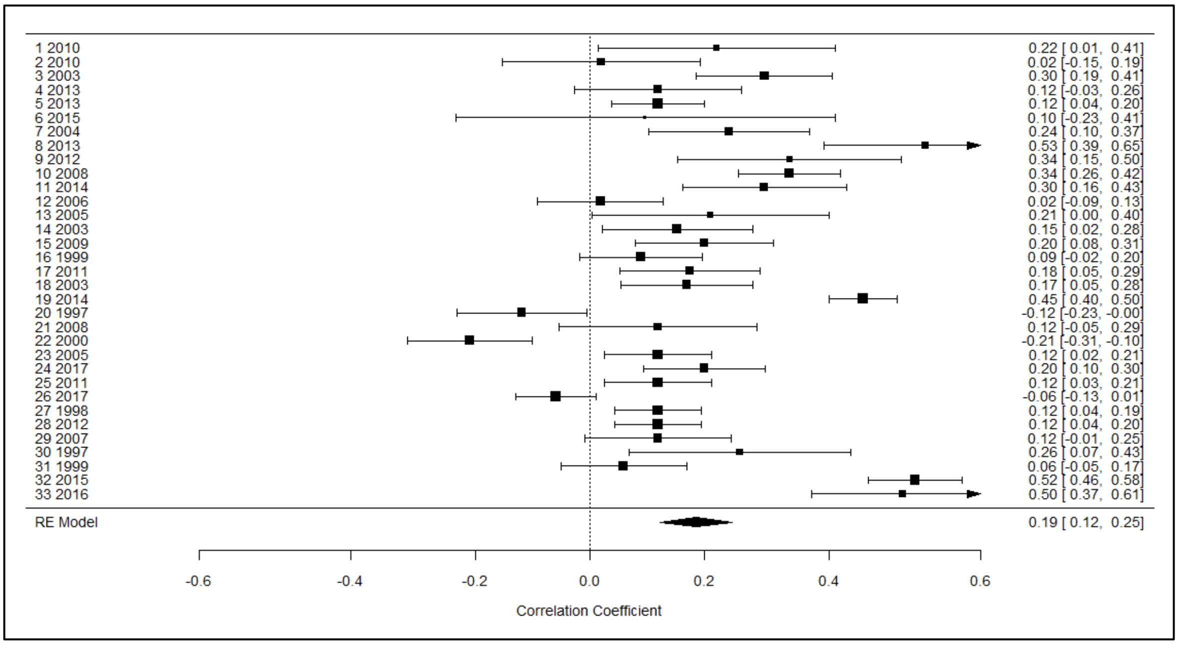

Figure 2.5. Extraversion Forest Plot Correlation Coefficient (Individual Sample). A good illustration of the studies that contributed to the mean observed correlation

2.19.3 Publication Bias

Funnel plot was included to visualize publication bias. Both plots (team and individual samples) do not show publication bias, since it has a symmetrical shape (See Figures 2.5 and 2.6). However, the illustration of the funnel plot can be subjective; therefore, a rank correlation test using Kendall's Tau and regression test were calculated through RStudio to test for funnel plot asymmetry at alpha 0.05.

Teams:	**Individuals:**
Regression Test: z = 1.1300, p = 0.2585	Regression Test: z = 0.5779, p = 0.5633
Kendall's: tau = 0.2493, p = 0.0423	Kendall's: tau = 0.2011, p = 0.1004
Egger Test t-score = 1.5347, p = 0.135	

Neither the regression nor the rank correlation test for individual sample shows any indications of publication bias. However, Kendall's test p-value (0.0423) for team sample shows some indication of publication bias. Therefore, the classical Egger Test was performed to test for Funnel Plot Asymmetry, utilizing the standard error as the predictor. Eggers Test did not show any significant p-value (0.135), which is why we can assume that there is no publication bias for extraversion.

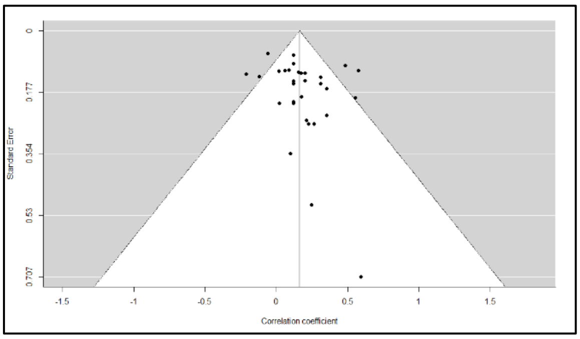

Figure 2.6. Funnel Plot Publication Team Sample

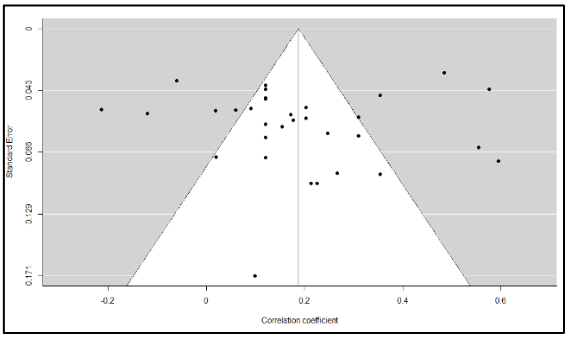

Figure 2.7. Funnel Plot Publication Individual Sample

2.20 Agreeableness

2.20.1 Statistical Significance of the Mean Effect Size

The estimated model of the mean effect size for agreeableness trait was statistically significant, with a p-value of < 0.0001 for both team and individual sample size. To further validate the result, zero is not included in both 95% CI, as seen above in Table 2.9. For agreeableness, it can be concluded that correlations are not the same across the 33 studies selected for the meta-analysis. Just as extraversion, agreeableness could be very diverse in population. It was also observed that the effect size between team and individual sample indicates a positive relationship. But, more interestingly, agreeableness mean effect size has a stronger relationship as a team (r0.172) than as individuals (r0.163) (see Table 2.10). This has to do with agreeableness dealing with interpersonal interactions and the tendency for individuals to be more cooperative, trusting, and sympathetic (Bradley et al., 2012; Chow, Then, & Skitmore, 2005; Driskell et al., 2006; O'Neill & Allen, 2010). Therefore, we can expect team members high on agreeableness to have a stronger relationship in a team setting environment than team members high on extraversion (EX r0.162, AG r0.172).

2.20.2 Examining Variability

It can be observed that mean estimated correlation for agreeableness has a Q-Statistic of 54.40 for team sample, and 351.73 for individual sample. Both Q-Statistic measures were significant, as shown in Table 2.8. Chi-Square value for df = 33 alpha 0.05 is 47.4; therefore, the null hypothesis is rejected for both team and individual samples, indicating the coefficient correlations across the selected studies for agreeableness are heterogeneous.

The I^2 indicates that there is 45.41% (team) and 91.60% (individuals) of variation due to heterogeneity reflected in the actual differences in the selected studies mean effect correlation. This means that agreeableness among the studies does not share a common effect size.

The I^2 indicates that there is 81.50% of variation reflected in the actual differences in the population mean, which supports agreeableness being heterogeneous. Testing for heterogeneity (d.f. 32), the p-values are 0.008 (team) and <0.0001 (individual), further validating that the mean effect size is not homogeneous. The I^2 for individual sample proves to be even more significant with a 91.60% variation, and heterogeneity testing of < 0.0001. This indicates that variation is higher when measuring team members individually than as a team.

A Baujat Plot was created to illustrate which studies are contributing to the overall heterogeneity for agreeableness. For the team sample, studies 32, 14, and 33 (see Figure 2.7) contribute more to the heterogeneity of agreeableness. These studies could also be considered as outliers, having either very low or very high correlation estimates (further from 0). For the individual sample, only study 33 (see Figure 2.8) contributes more to the heterogeneity of agreeableness.

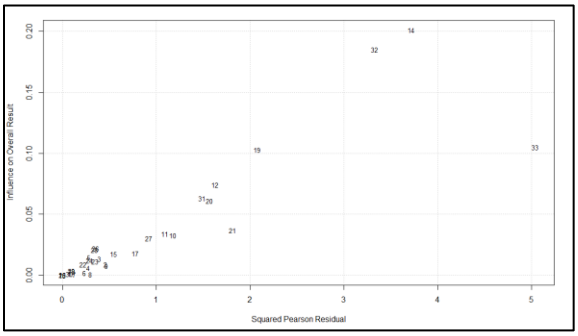

Figure 2.8. Agreeableness Baujat Plot for Team Sample

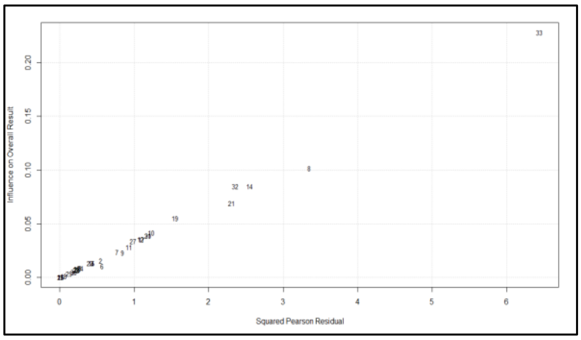

Figure 2.9. Agreeableness Baujat Plot for Individual Sample

The forest plots below demonstrate which studies have influenced the mean effect size for agreeableness in the selected studies. Figures 2.9 and 2.10 are graphical representations of team and individual samples, respectively.

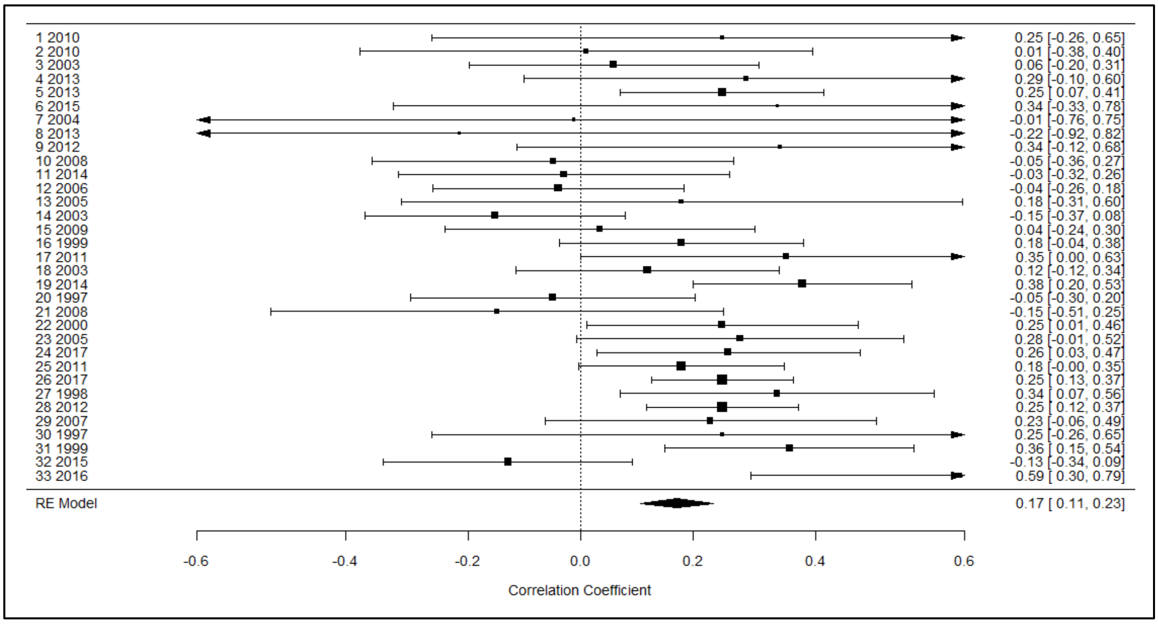

Figure 2.10. Agreeableness Forrest Plot Correlation Coefficient (Team). A good illustration of the studies that contributed to the mean observed correlation

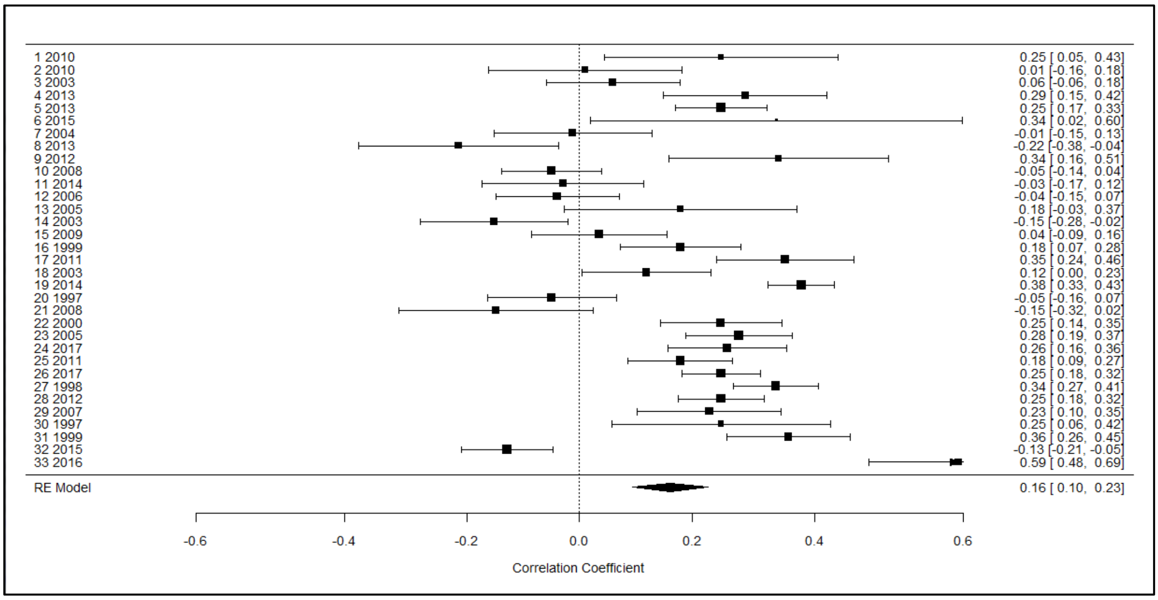

Figure 2.10. Agreeableness Forrest Plot Correlation Coefficient (Individual). A good illustration of the studies that contributed to the mean observed correlation

2.20.3 Publication Bias

Funnel plot was included to visualize publication bias. Both plots (team and individual samples) do not show publication bias, since it has a symmetrical shape (See Figures 2.11 and 2.12). However, the illustration of the funnel plot can be subjective; therefore, a rank correlation test using Kendall's Tau and regression test were calculated through RStudio to test for funnel plot asymmetry at alpha 0.05.

Teams:		**Individuals:**	
Regression Test:	z = -0.2095, p = 0.8341	Regression Test:	z = -0.0462, p = 0.9632
Kendall's:	tau = -0.0895, p = 0.4661	Kendall's:	tau = -0.1556, p = 0.2038

Neither the regression nor the rank correlation test (both samples) was statistically significant, which shows that there is no evidence of publication bias for agreeableness.

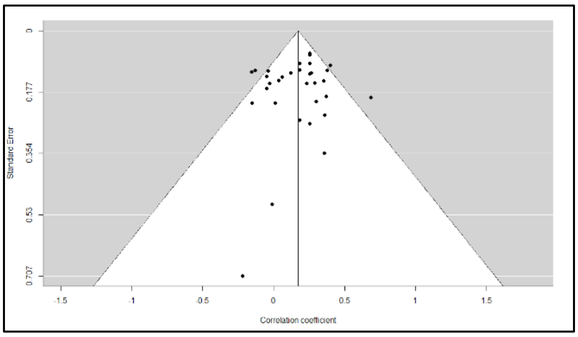

Figure 2.11. Funnel Plot Publication Team Sample

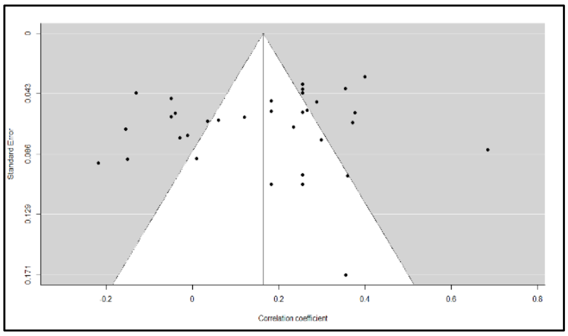

Figure 2.12. Funnel Plot Publication Individual Sample

2.21 Conscientiousness

2.21.1 Statistical Significance of the Mean Effect Size

The estimated model of the mean effect size for conscientiousness trait was statistically significant with a p-value of < 0.0001 for both team and individual sample size. To further validate the results, zero was not included in both 95% C.I. as seen in Table 2.9. For conscientiousness, it can be concluded the correlations are not the same across the 33 studies selected for the meta-analysis. Just as extraversion and agreeableness, conscientiousness could be very diverse in the population. It was also observed that the effect size between team and individual sample indicates a positive relationship.

However, the relationship is stronger when evaluating team members' personality traits individually than as a team average. The effect size for team is r0.208, and the effect size for individual is r0.232. There is a possibility that conscientiousness in a team is better evaluated per team member than averaging the score of all team members. The reason why conscientiousness is higher in individual sample could be linked to what Bradley et al. (2012) mentioned. Bradley et al. (2012) suggested that conscientiousness is the trait with facets that deal with performance at the individual level, but this can be different depending on the team's needs and project requirements. Juhász (2010) mentioned that conscientiousness could be positively related to team performance only when both the team and the leader's levels of conscientiousness are high. Guchait, Hamilton, and Hua (2014) concluded that team members with high conscientiousness are likely to be detailed-oriented. This suggests that team leaders and team members should be high on conscientiousness to acquire team performance.

2.21.2 Examining Variability

It can be observed that mean estimated correlation for conscientiousness has a Q-Statistic of 35.02 for team sample, and 164.85 for individual sample. Q-Statistic measure for team is not statistically significant, with a p-value of 0.3268. However, for individual sample Q-Statistic measure is statistically significant with a p-value of <0.0001 (see Table 2.8). To further access the results, the Chi-Square value for df = 33 alpha 0.05 is 47.4, which is higher than the model of Q = 35.02. Therefore, the null hypothesis cannot be rejected for team sample, indicating that coefficient correlations across the studies for conscientiousness are homogeneous (common correlation values). For the individual sample, the null hypothesis is rejected (Q = 164.85), indicating that coefficient correlations are not homogeneous.

The I^2 indicates that there is 19.37% (team) and 83.61% (individuals) of variation due to heterogeneity reflected in the actual differences in the selected studies on mean effect correlation. This shows that conscientiousness, when accessed as a team, has a common effect size among the selected studies. However, when accessed per individual, the selected studies do not share a common effect size.

Testing for heterogeneity (d.f. 32), the p-values are 0.3268 (team) and <0.0001 (individual), further validating that the mean effect size is homogeneous for team sample, and not for individual sample. The I^2 for individual sample proves to be even more significant with 83.61% variation, and heterogeneity testing of < 0.0001. This indicates that variation is higher when measuring team members individually than as a team. However, it also shows that there are more studies focusing on conscientiousness, asthis is the personality trait most used for measuring team performance. The tests demonstrate that the coefficient correlations tend to be more common for conscientiousness in the literature review.

A Baujat Plot was created to illustrate which studies are contributing to the overall heterogeneity for conscientiousness. For the team sample, studies 12, 33, 20, and 11 (see Figure 2.13) contribute more to the heterogeneity of conscientiousness, which could be considered as outliers, as they have either very low or very high correlation estimates (further from 0). For the individual sample, studies 12, 20, 11, and 33 (see Figure 2.14) contribute more to the heterogeneity of conscientiousness. Only for conscientiousness, it was observed that the same studies were found to be outliers for both samples (team and individual).

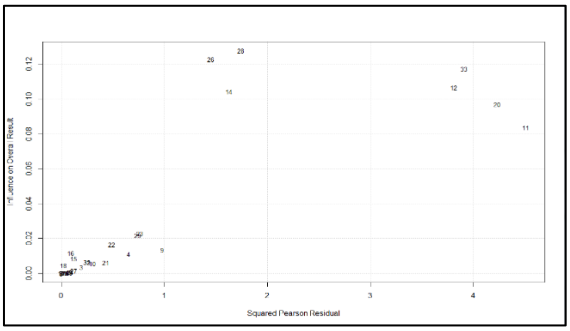

Figure 2.13. Conscientiousness Baujat Plot for Team Sample

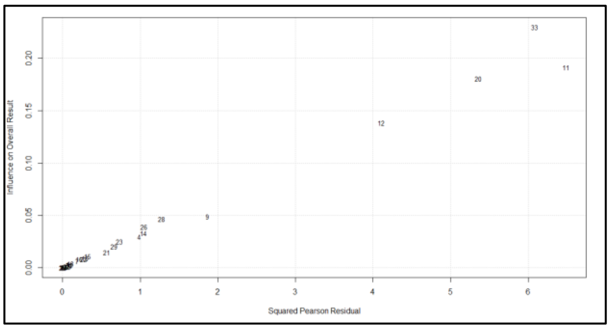

Figure 2.14. Conscientiousness Baujat Plot for Individual Sample

The forest plots below demonstrate which studies have influenced the mean effect size for conscientiousness in the selected studies. Figures 2.15 and 2.16 are graphical representations for team and individual samples.

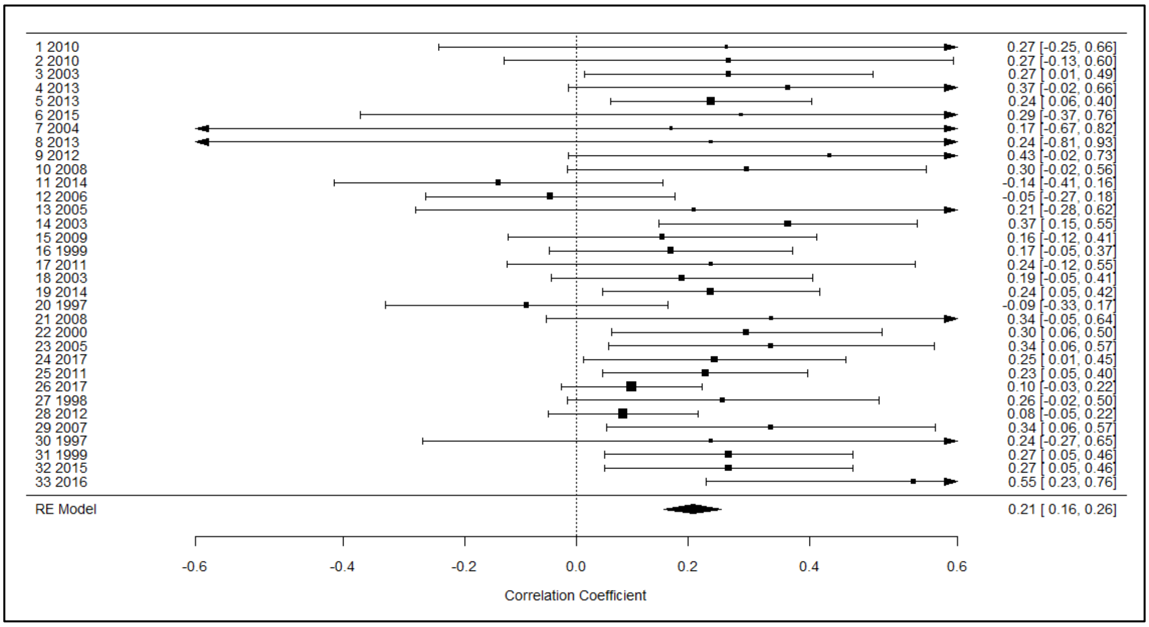

Figure 2.15. Conscientiousness Forrest Plot Correlation Coefficient (Team). A good illustration of the studies that contributed to the mean observed correlation

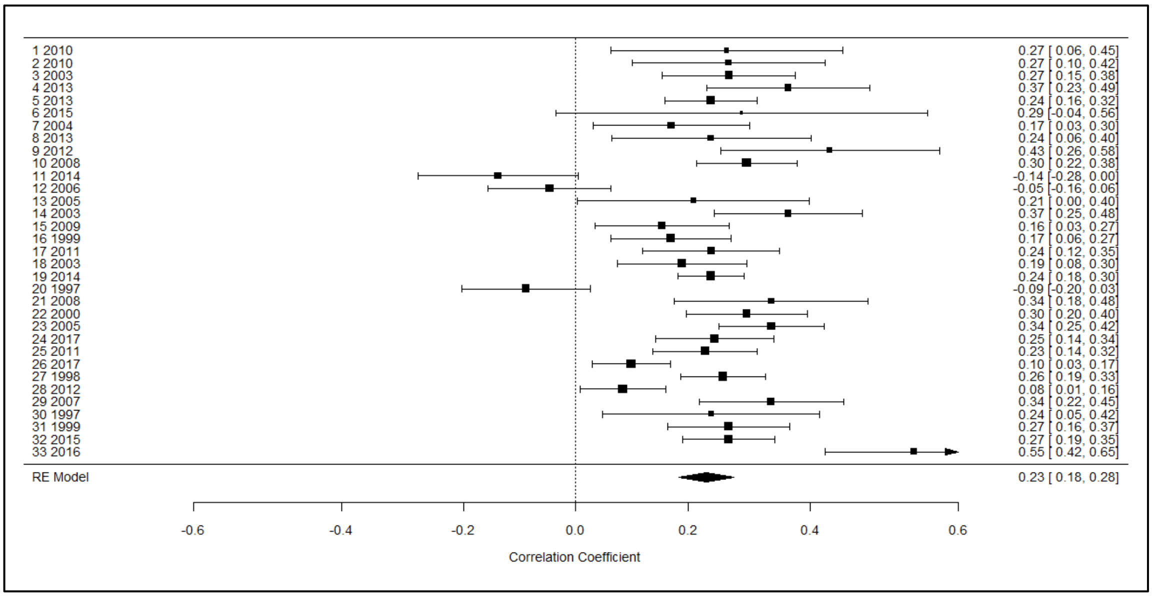

Figure 2.16. Conscientiousness Forrest Plot Correlation Coefficient (Individual). A good illustration of the studies that contributed to the mean observed correlation

2.21.3 Publication Bias

Funnel plot was included to visualize publication bias. Both plots (team and individual samples) do show publication bias since it has an asymmetrical shape (See Figure 2.17 and 2.18). However, the illustration of the funnel plot can be subjective; therefore, a rank correlation test using Kendall's Tau and regression test were calculated through RStudio to test for funnel plot asymmetry at alpha 0.05.

Teams:

Regression Test: z = 2.0064, p = 0.0448

Kendall's: tau = 0.0629, p = 0.6089

Egger Test t-score = 2.1855, p = 0.0365

Individuals:

Regression Test: z = 1.2771, p = 0.2016

Kendall's: tau = 0.0417, p = 0.7331

Neither the regression nor the rank correlation test for individual sample shows any indications of publication bias. However, the regression test for team demonstrates that there might be evidence of publication bias with a p-value of 0.0488. Therefore, the classical Egger test was performed to test for Funnel Plot Asymmetry utilizing the standard error as the predictor. Eggers test also shows some evidence of publication bias, with a p-value of 0.035.

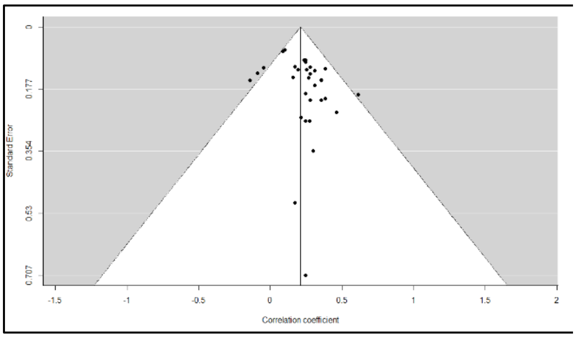

Figure 2.17. Funnel Plot Publication Team Sample

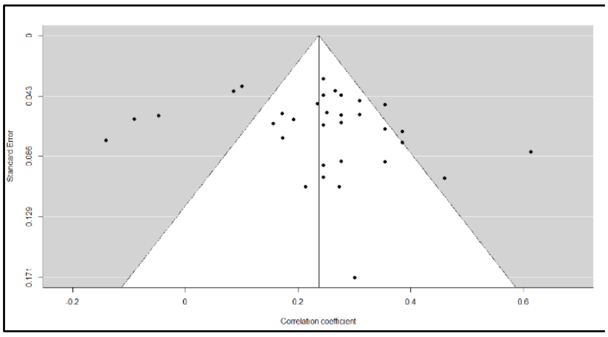

Figure 2.18. Funnel Plot Publication Individual Sample

Since the funnel plot is asymmetrical and the regression and Egger test failed, a trim-and-fill process was conducted to see how many more studies were needed to make it symmetrical. A meta-analysis will be conducted on the trim-fill method results to observe the new estimate (including the missing studies). The trim-and-fill has produced an estimated eleven missing studies on the left side, and an estimate of 0.1592, which is smaller than the original estimate of 0.2111 (see Figure 2.19). The C.I. for the trim-and-fill did not include zero (0.1083, 0.210). According to Cooper (2016), if the C.I. of the recalculated estimate does not include zero, it gives more confidence that the results would not have changed dramatically if the missing data were found. However, to provide assurance, a t-test was performed between the two estimates.

Null Hypothesis: X2 – X1 = 0

Alternative Hypothesis: X2 – X1 ≠ 0

d.f.: (33-1) = 32, for two-sided distribution t* = 2.037 at 0.05

SE1 = 0.0268

SE2 = 0.0259

$$\mathrm{SE_{diff}} = \sqrt{\mathrm{SE_1^2 + SE_2^2}} \qquad \text{Equation (10)}$$

$$\mathrm{t} = \frac{\mathrm{x_2 - x_1}}{\mathrm{SE_{diff}}}$$

Equation (11)

$$\mathrm{C.I._{0.05} = x_2 - x_1 \pm (t^* * SE_{diff})}$$

Results: t = -1.393, C.I. (-0.128, 0.024)

The confidence interval includes zero, which is why there are no significant differences between the trim-and-fill and the original estimates. Fail-safe N calculation using the Rosenberg ppproach has produced 628 studies needed to change the mean effect size. Therefore, this is enough evidence that supports that there is no publication bias in the conscientiousness trait.

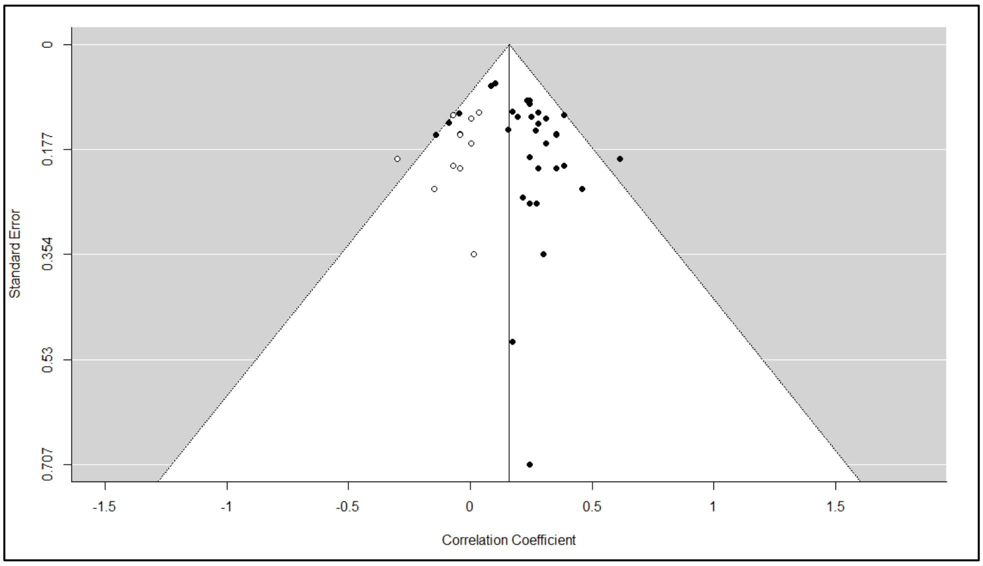

Figure 2.19. Trim and Fill Funnel Plot Publication Bias for Conscientiousness

2.22 Neuroticism

2.22.1 Statistical Significance of the Mean

The estimated model of the mean effect size for neuroticism trait was not statistically significant with a p-value of 0.4136 for team sample and 0.1692 for individual sample. To further validate the results, zero was included in both 95% C.I. as seen in Table 2.9. Regarding neuroticism, it can be concluded that correlations are the same across the 33 studies selected for the meta-analysis. This could be due to the lack of studies focusing on the negative aspects of team personality, which has led to a very small amount of studies reporting on coefficient correlation estimates. Even though a negative relationship was not observed in the meta-analysis for neuroticism, it had the lowest mean effect size from the 33 studies selected. A high level of neuroticism can be detrimental to team performance, cohesion, and decision making (Driskell et al., 2006; Juhász, 2010; O'Neill & Allen, 2010) thus making it the least desirable trait.

2.22.2 Examining Variability

It can be observed that the mean estimated correlation for neuroticism has a Q-Statistic of 27.63 for team sample, and 172.04 for individual sample. Q-Statistic measure for team is not statistically significant with a p-value of 0.6877. However, for individual sample, Q-Statistic measure is statistically significant with a p-value of <0.0001 (see Table 2.7). To further assess the results, the Chi-Square value for df = 33 alpha 0.05 is 47.4, which is higher than the model of Q = 27.63. Therefore, the null hypothesis cannot be rejected for team sample, indicating that coefficient correlations across the studies for neuroticism are homogeneous (common correlation values). For the individual sample, the null hypothesis is rejected (Q = 172.04), indicating that coefficient correlations are not homogeneous.

The I^2 indicates that there is 6.13% (team) and 81.62% (individuals) of variation due to heterogeneity reflected in the actual differences in the selected studies mean effect correlation.

This shows that, when assessed as a team, the selected studies share a common effect size for neuroticism. However, when assessed per individual, the selected studies do not share a common effect size.

Testing for heterogeneity (d.f. 32), the p-values are 0.6877 (team) and <0.0001 (individual), further validating that the mean effect size is homogeneous for team sample, and not homogeneous for individual sample. The I^2 for individual sample proves to be even more significant, with a 81.62% variation, and heterogeneity testing of < 0.0001. This indicates that variation is higher when measuring team members individually than as a team.

A Baujat Plot was created to illustrate which studies are contributing to the overall heterogeneity for neuroticism. For the team sample, studies 18 and 5 (see Figure 2.20) contribute more to the heterogeneity of neuroticism, and they could be considered as outliers, having either very low or very high correlation estimates (further from 0). For the individual sample, studies 18 and 9 (see Figure 2.21) contribute more to the heterogeneity of neuroticism.

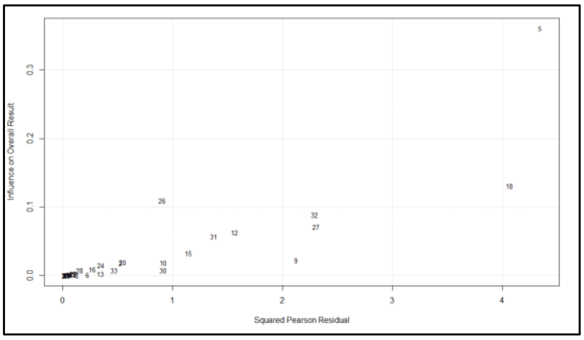

Figure 2.20. Conscientiousness Baujat Plot for Team Sample

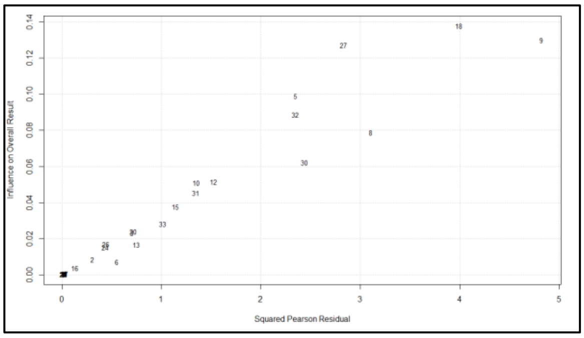

Figure 2.21. Conscientiousness Baujat Plot for Individual Sample

The forest plots below demonstrate which studies influenced the mean effect size for neuroticism in the selected studies. Figure 2.22 and 2.23 is a graphical representation for team and individual samples, respectively.

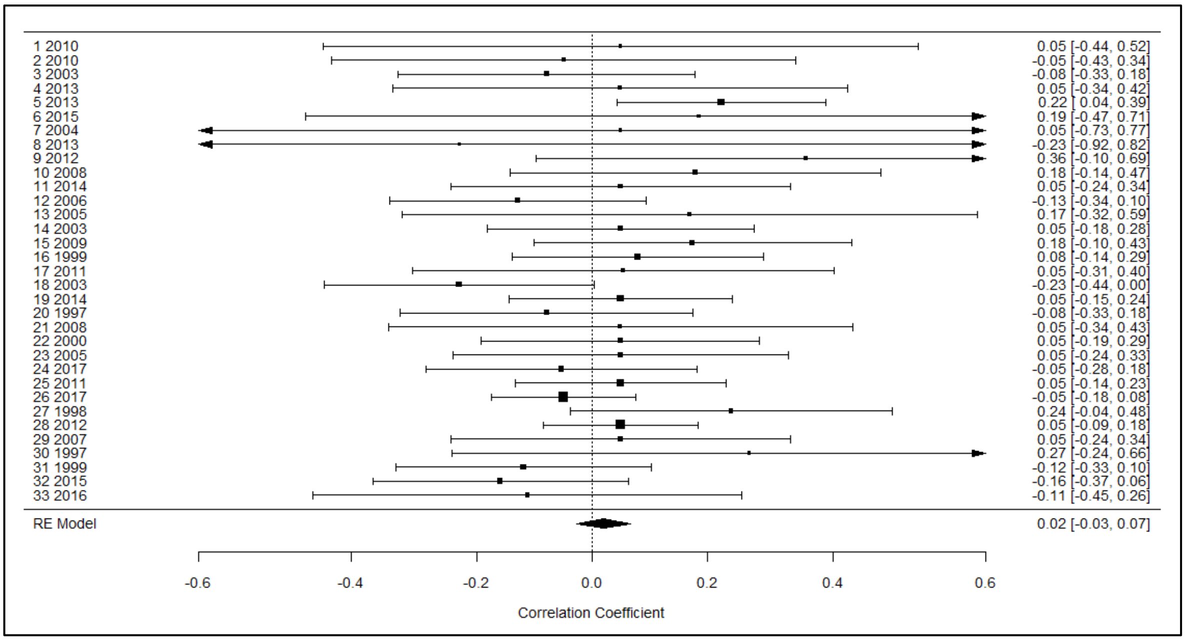

Figure 2.22. Neuroticism Forest Plot Correlation Coefficient (Team). A good illustration of the studies that contributed to the mean observed correlation

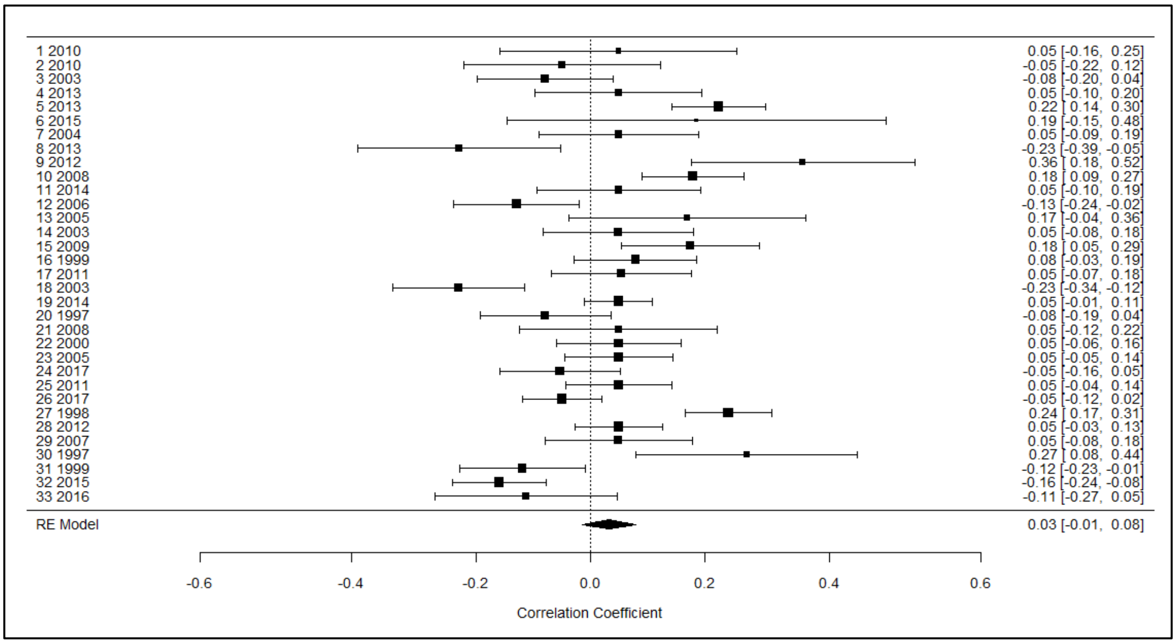

Figure 2.23. Neuroticism Forest Plot Correlation Coefficient (Individual). A good illustration of the studies that contributed to the mean observed correlation

2.22.3 Publication Bias

Funnel plot was included to visualize publication bias. Both plots (team and individual samples) show publication bias, since it has an asymmetrical shape (See Figures 2.24 and 2.25). However, the illustration of the funnel plot can be subjective; therefore, a rank correlation test using Kendall’s Tau and regression test were calculated through RStudio to test for funnel plot asymmetry at alpha 0.05.

Teams:		**Individuals:**	
Regression Test:	z = 0.9061, p = 0.3649	Regression Test:	z = 0.8453, p = 0.3979
Kendall’s:	tau = 0.0210, p = 0.8646	Kendall’s:	tau = -0.0721, p = 0.5559

Neither the regression nor the rank correlation test (both samples) was statistically significant, which shows no evidence of publication bias for neuroticism.

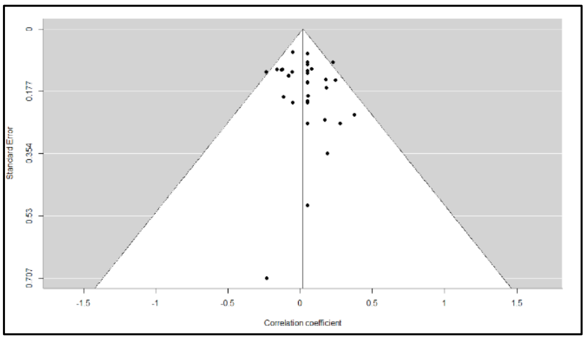

Figure 2.24. Funnel Plot Publication Team Sample

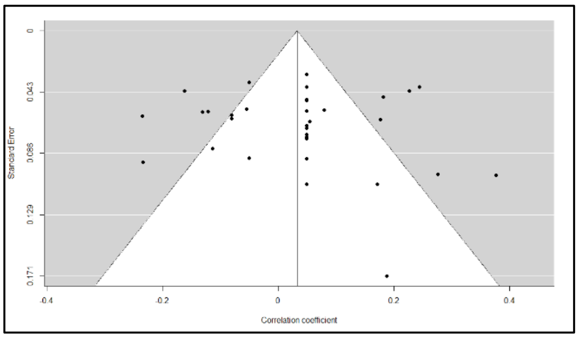

Figure 2.25. Funnel Plot Publication Individual Sample

2.23 Open to Experience

2.23.1 Statistical Significance of the Mean

The estimated model of the mean effect size for open-to-experience trait was statistically significant with a p-value of < 0.0001 for both team and individual sample size. To further validate the result, zero is not included in both 95% C.I. as seen in Table 2.9. For open to experience, it can be concluded the correlations are not the same across the 33 studies selected for the meta-analysis. It was also observed that the effect size between team and individual sample indicates a positive relationship. More interestingly, open to experience mean effect size has a stronger relationship as a team (r0.150) than as an individual (r0.147) (see Table 2.10).

2.23.2 Examining Variability

It can be observed that mean estimated correlation for open to experience has a Q-Statistic of 21.70 for team sample, and 126.58 for individual sample. Q-Statistic measure for team is not statistically significant with a p-value of 0.9152. However, for individual sample, Q-Statistic measure is statistically significant with a p-value of <0.0001 (see Table 2.8). To further assess the results, the Chi-Square value for df = 33 alpha 0.05 is 21.70, which is higher than the model of Q = 27.63. Therefore, the null hypothesis cannot be rejected for team sample, indicating that coefficient correlations across the studies for open to experience are homogeneous (common correlation values). For the individual sample, the null hypothesis is rejected (Q = 126.58), indicating that coefficient correlations are not homogeneous. Open to experience also had the smallest count of reported correlation estimates from the selected studies. This could mean that not many studies investigate the influence of open to experience on team performance. The same was observed with neuroticism.

The I^2 indicates that there is 0.0% (team) and 80.16% (individuals) of variation due to heterogeneity reflected in the actual differences in the selected studies mean effect correlation. This shows that open to experience for team sample shares a common effect size as opposed to individual sample. Testing for heterogeneity (d.f. 32), the p-values are 0.9152 (team) and <0.0001 (individual), further validating that the mean effect size for team is homogeneous and not homogeneous for individual.

A Baujat Plot was created to illustrate which studies contribute to the overall heterogeneity for open to experience. For the team sample, studies 20 and 33 (see Figure 2.26) contribute more to the heterogeneity of open to experience, which could be considered as outliers, having either very low or very high correlation estimates (further from 0). For the individual sample, studies 2, 30, and 33 (see Figure 2.27) contribute more to the heterogeneity of open to experience.

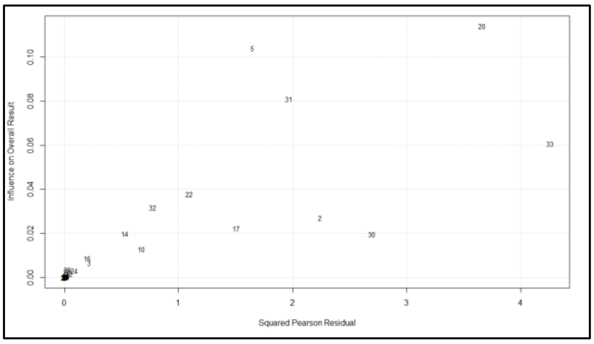

Figure 2.26. Open to Experience Baujat Plot for Team Sample

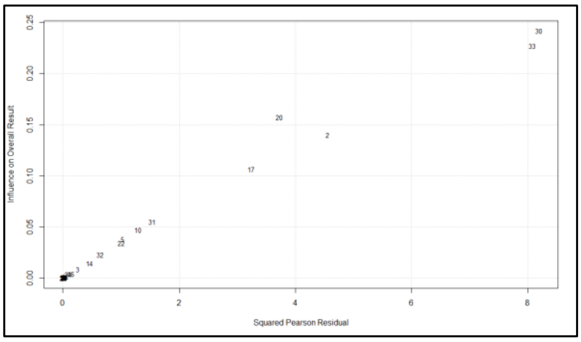

Figure 2.27. Open to Experience Baujat Plot for Individual Sample

The forest plots below demonstrate which studies have influenced the mean effect size for open to experience in the selected studies. Figures 2.28 and 2.29 are graphical representations for team and individual samples, respectively.

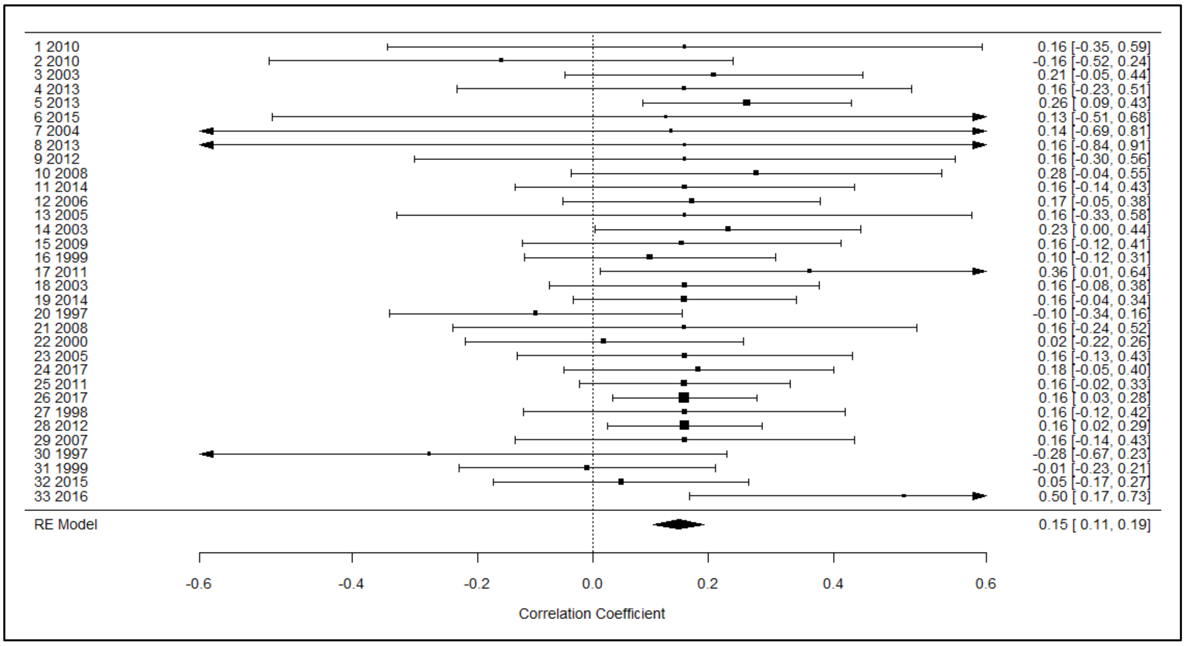

Figure 2.28. Open to Experience Forrest Plot Correlation Coefficient (Team). A good illustration of the studies that contributed to the mean observed correlation

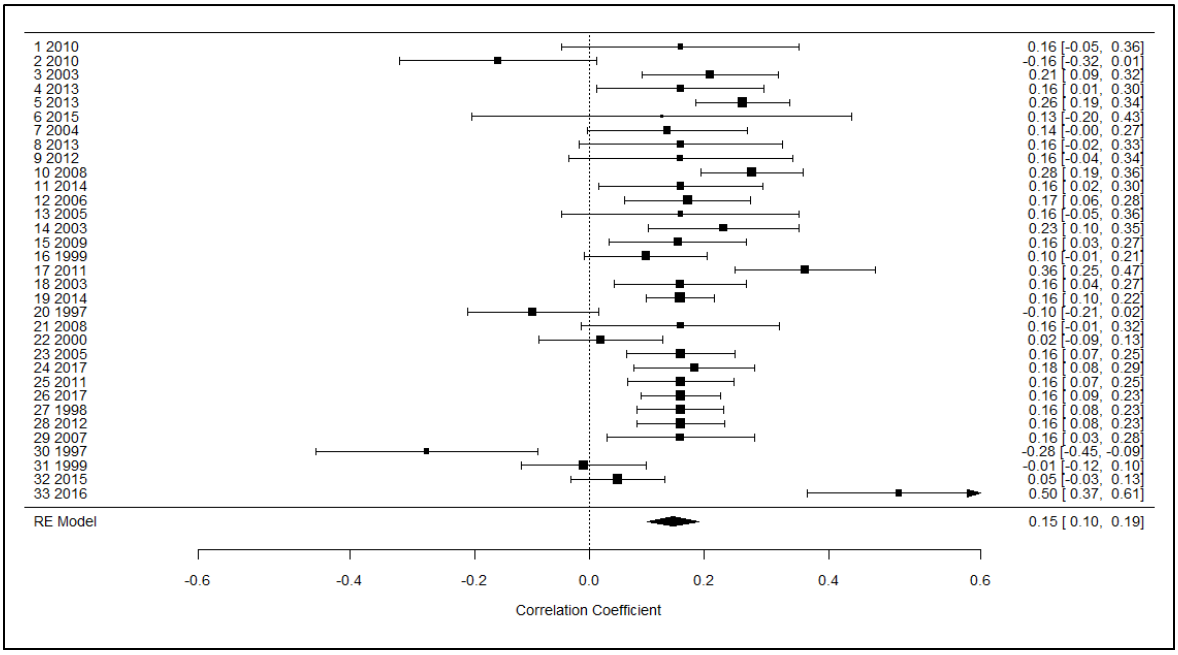

Figure 2.29. Open to Experience Forrest Plot Correlation Coefficient (Individual). A good illustration of the studies that contributed to the mean observed correlation

2.23.3 Publication Bias

Funnel plot was included to visualize publication bias. Both plots (team and individual samples) do not show publication bias since it has a symmetrical shape (See Figures 2.30 and 2.31). However, the illustration of the funnel plot can be subjective; therefore, a rank correlation test using Kendall's Tau and regression test were calculated through RStudio to test for funnel plot asymmetry at alpha 0.05.

Teams:	**Individuals:**
Regression Test: z = -0.2808, p = 0.7788	Regression Test: z = -0.7383, p = 0.4603
Kendall's: tau = -0.2724, p = 0.0266	Kendall's: tau = -0.2735, p = 0.0256
Egger Test t-score = -0.3363, p = 0.7389	Egger Test t-score = -0.6231, p = 0.5378

For the team sample, the regression test shows no publication bias, unlike the Kendall's test, which shows some evidence of publication bias. For the individual sample, both the Regression and Kendall's tests show some evidence of publication bias. Therefore, Egger test was implemented to further assess the issues. The Egger test p-values were statistically significant for both samples, showing that there is no evidence of publication bias for open to experience.

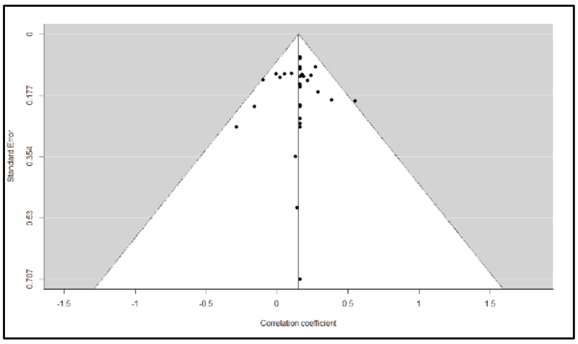

Figure 2.30. Funnel Plot Publication Team Sample

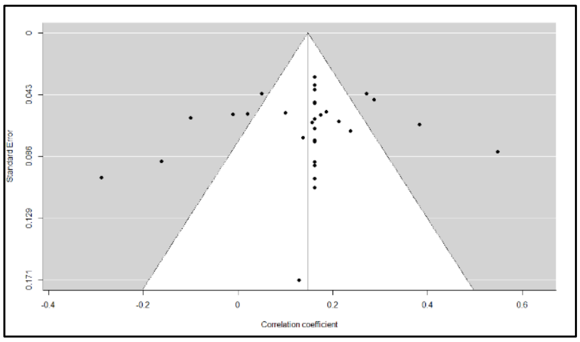

Figure 2.31. Funnel Plot Publication Individual Sample

2.24 Interpretation of Results

The estimated mean correlation (see Table 2.6) for conscientiousness is 0.208 for team sample and 0.232 for individual sample, which was the largest from the five personality traits followed by agreeableness, extraversion, open to experience, and neuroticism. Conscientiousness was also found to have the highest correlation for personality and team performance in this meta-analysis. As expected, neuroticism has the lowest correlation for personality traits and team performance. The variability of the estimated mean correlation of extraversion, agreeableness, conscientiousness, and open to experience is constant when evaluating individual as the sample size in the team. However, it was observed that variability is smaller when evaluating team correlation as an average, or single unit. This implies that the coefficient correlation measures reported in the selected studies share a common effect size. The relationship strength between personality traits and team performance is important, and it was observed that correlation effect size changes between team and individual samples, with an increase in correlation effect size for extraversion and conscientiousness (r0.162 to r0.185 and r0.208 to r0.232). There is a possibility that extraversion and conscientiousness for team is better evaluated per team member than averaging the score of all team members. The literature review has also indicated that conscientiousness could be higher as an individual score because of facets that deal with performance at the individual level (Bradley et al. (2012). Also, Juhász (2010) mentioned that conscientiousness could be positively related to team performance only when both the team's and the leader's levels of conscientiousness are high.

Four subjects were reported, including students, engineering, business, and military, from which the data was obtained. 55% belong to students, 33% to engineering, 6% to engineering, and 6% to military. Most studies investigating personality traits and team performance were conducted at educational institutions, which might be due to student subjects' easy access to educational institutions. The next largest group is engineering, which can be tied to larger engineering firms conducting personality investigation seeking to improve team performance at their facilities. The engineering group has not included any construction; thus, it further demonstrates that the construction industry needs more studies seeking to understand how personality could influence team performance.

The meta-analysis assisted in summarizing, appraising, and analyzing the personality traits that influence team performance, trying to answer the two questions:

- Q1 - What personality traits can influence team performance?

According to the meta-analysis, the personality traits that have more influence (stronger relationship) on team performance are conscientiousness (0.208–0.232), extraversion (0.162–0.185), and agreeableness (0.172–0.163), with conscientiousness having the strongest influence.

- Q2 - How do personality traits influence team performance?

Teams must go through interactions, not only with people but also in different environments that could affect the way they behave and learn. Therefore, different personality characteristics become implications when interacting in social environments where personality characteristics are the elements of interaction (Sarason & Holzman, 1999). Thus, interaction, along with personality, has an influence on team performance that is positive or negative.

Conscientiousness influences team performance because team members are more detail-oriented, and volunteer in task-focused activities, which help understand the task requirements and team members' responsibilities (Guchait, Hamilton, & Hua, 2014; O'Neill & Allen, 2010). Extraversion influences team performance because team members are very sociable, and like to resolve issues as a team with constructive resolutions (Bradley, Klotz, Postlethwaite, & Brown, 2012). Agreeableness influences team performance because team members are more cooperative, trusting, honest, supportive, and sympathetic (Bradley et al., 2012; Chow, Then, & Skitmore, 2005; Driskell et al., 2006; O'Neill & Allen, 2010).

The hypothesis for this meta-analysis was rejected, since the results show differences between the mean effect size among the selected studies, except for measuring the mean effect size utilizing teams as the sample size. The personality traits that shared common mean effect size are conscientiousness, neuroticism, and open to experience. Some of the homogeneity levels for neuroticism and open to experience could be due to missing data, replaced with Bell (2007) meta-analysis results. As mentioned above, conscientiousness homogeneity within a team sample can be due to the fact that most studies use conscientiousness as the main trait to measure team performance. A high variability in the individual sample needs more investigation to get a better understanding of why the mean effect size is not common.

2.25 Chapter 2 Conclusion

In this study, a meta-analysis was applied to investigate which personality traits are more significant for team performance in the literature. The meta-analysis was also applied to verify if the mean estimated correlation of the personality traits were different between the studies found in the literature. Research questions one and two of this research were successfully answered.

Q1 - How do personality traits influence team performance?

Several studies were collected from the literature related to personality traits influencing team performance to answer question one. The meta-analysis procedure was applied to the selected studies, and an effect size estimate was calculated for each personality trait to determine their level of influence. A heterogeneity estimate (Q-Statistic and I2) was used to determine differences in effect size. According to the meta-analysis, from most influential to least based on the existing literature at the team level, the personality traits were arranged as follows conscientiousness, agreeableness, extraversion, openness to experience, and neuroticism (see Table 2.10). Based on the effect size from the literature review, it was assumed that in construction projects, conscientiousness, agreeableness, extraversion, and openness to experience would positively influence team performance. It was also believed that neuroticism would have a negative impact on team performance. The meta-analysis revealed that agreeableness, extraversion among the studies do not share a common effect size. Which further validated that the mean effect size is not homogeneous. The meta-analysis revealed that conscientiousness and openness to experience coefficient correlations (at the team level) across the studies are homogeneous (common correlation values). Neuroticism was also found to be homogeneous at the team level, but this was likely due to the lack of studies investigating neuroticism and its influence on team performance.

Q2 - How do personality traits influence team performance?

The method explored in this study consisted of personality traits and team criteria as the input (independent variables) and team performance as the output (dependent variable). Team criteria measured the team output (team performance), which assessed the interactions of team members from nine common attributes (team composition, team information sharing, team productive output, team survivability, team member satisfaction, shared values/goals/cultured, commitment/responsibility, communication/information sharing, and trust/respect) when working together. Thus, this study utilized other investigations that used the common attributes to explore if personality traits influence team performance. The main goal was to demonstrate that personality traits could assess team performance in construction projects. From the same selected studies used in the meta-analysis, research question two was successfully answered by reviewing in-depth each study to find a meaningful connection between personality traits and team criteria used to measure team performance. The review revealed that team members' interactions, along with their personalities, have an impact on team performance, either positive or negative. The review of the selected studies gave a clear understanding of the impact personality traits have on team performance and how they can be used in conjunction with team criteria. The clear understanding revealed from the selected case studies is detailed in Table 1.1 in chapter one for individuals and Table 3.5 for team-level construct, a spectrum (low = 1 to high = 5) of how personality traits influence team performance.

Overall, the authors found that EX, AG, CO, NE, and OP are heterogenetic across the 33 selected studies when analyzed utilizing individual sample size. However, it was also found that conscientiousness, neuroticism, and open to experience are homogeneous when using the team sample size in data analysis. It was also found that conscientiousness has the highest correlation with most studies, indicating that it is a good trait for team performance. It was also confirmed that neuroticism has negative effects on team performance, with the lowest correlation value across the selected studies.

There were a few limitations in this meta-analysis: The first limitation was the sample size of the meta-analysis. Since the keywords used were specific to personality traits and team performance, this produced a low number of studies. The second limitation has to do with the lack of construction team studies on personality traits and team performance. The focus of this paper is construction teams, but, due to a lack of studies, other studies unrelated to construction had to be included to determine the mean effect size. There is a possibility that construction teams might observe different correlation values for personality and team performance. The third limitation is related to the subjects of the studies. Most of the studies used university students to determine the correlation values. However, there is a difference in experience, age, and environment between classrooms and construction projects. Bell (2007) confirmed in her meta-analysis that team field settings tend to have higher correlation values than in class team settings (Bell, 2007). Therefore, more research needs to be conducted with construction professionals to determine the actual correlation values when predicting team performance based on personality traits in real construction projects.

The findings in this study have revealed the need for research on construction team's personality traits and how it can affect team performance. Since heterogeneity is high for the mean effect size in the 33 selected studies, personality traits correlation values for construction teams could be different from other sample subjects, such as students, business corporations, and other engineering firms unrelated to construction. Therefore, at this point, it is unclear how personality traits can predict team performance in construction settings, but the results in this meta-analysis could be used as a control point when conducting personality studies in the construction industry.

CHAPTER 3: THEORETICAL FRAMEWORK/METHODOLOGY

3.1 Introduction

Researchers in the construction industry have identified and addressed various issues of team performance that project teams frequently encounter during the design and construction processes of a project, by developing guidance and frameworks to integrate these teams, also known as team criteria. However, these approaches have not yet completely and holistically addressed the identified problems because of complicated and unrevealed personality differences among the team members. Consequently, a meta-analysis was conducted in this study, and it was observed that the construction industry continues to overlook personality differences and its influence on team performance. Nonetheless, after a review of the literature, there is little research being conducted in the construction industry that studies the influence of personality in team performance. Researchers related to business, military, and education have conducted extensive studies as an effort to determine the extent of the influence of personality on team performance; the meta-analysis demonstrated that most of the subjects in the selected studies were either students or businesses. Therefore, this leads to the creation of the hypothesis: Construction team members' personalities and team criteria influence team performance.

How important are personality characteristics as criteria, alongside team criteria, to measure team performance? According to Goldberg (1993), investigations focused on finding a correlation between personality characteristics and team performance are critical in assisting employees' recruitment or performance. It is clear to society that behavior substantially affects job performance, especially when their personality characteristics conflict with team performance (Goldberg, 1993). However, in the construction industry, traditional delivery methods generally select team members using low bid procurement (Zuber et al., 2018). As a result, personality and team criteria have been overlooked in the process of selecting team members or measuring team performance. Therefore, a prediction of team performance based on personality and team criteria is an appropriate approach to evaluate construction project teams. Thus, a suitable research design must be selected to obtain reliable measurements to answer the research questions of this study.

Analysis of team performance varies according to different construction project circumstances, such as the type of construction, design complexity, project location, type of contract, type of delivery method, and project participants (Liyanage & Villalba-Romero, 2015). Thus, this research investigates if personality traits and team criteria influence team performance, which will be the condition factors to perform a qualitative comparison analysis (QCA). While team performance has other factors, this research will focus on personality traits and team criteria (TC) only.

Personality traits have been established previously, which, according to (Li, Zhou, Zhao, Zhang, & Zhang et al., 2015), include extraversion (EX), agreeableness (AG), conscientiousness (CO), neuroticism (NE), and open to experience (OP). All five traits of the BFF will be utilized in this study to investigate if the combination of different personality traits influences team performance. The meta-analysis concluded that there is a positive correlation between EX, AG, and CO that influences team performance. NE was found to have a negative correlation, and OP was either positive or negative, depending on team objectives.

Regarding team criteria, the common attributes in the literature related to team performance are trust and respect, communication, commitment, shared culture, team leadership, shared goals, cohesion, cooperation, responsibility, management approach, information sharing, collaboration, flexibility, honesty, efficiency, continual improvement, pride, experience, and timeliness. Team criteria is further explained in the data collection section, under field observations.

QCA can be described as an approach that assists in analyzing complex social phenomena in small-size cases, utilizing Boolean algebra instead of correlational methods, by combining qualitative and quantitative analysis methods (Devers et al., 2013; Ragin, 2009). The QCA approach utilizes the criteria of an investigation and combines it to find combinations that will produce an outcome. According to Liyanage and Villalba-Romero (2015), normally, QCA is applied in social, political, historical, and medical studies; however, in the last several years, QCA has been applied to construction-related studies. See Table 3.1 for a list of recent construction-related studies utilizing QCA. For this study, the outcome of interest is team performance and how it is influenced by personality and team criteria. The QCA process is further explained in the analysis section of this proposal.

Table 3.1. Construction related studies utilizing QCA

Authors	**Title**
McAdam et al. (2010)	Site Fights: Explaining Opposition to Pipeline Projects in the Developing World
Schaffer-Boudet, Jayasundera, and Davis (2011)	Drivers of Conflict in Developing Country Infrastructure Projects: Experience From the Water and Pipeline Sectors
Gross and Garvin (2011	Structuring PPP Toll-road Contracts to Achieve Public Pricing Objectives
Jin Ouk Choi, O'Connor, and Tae WanKim (2016)	Recipes for Cost and Schedule Successes in Industrial Modular Projects: Qualitative Comparative Analysis
Homayouni, Sturts Dossick, and Neff (2014)	Achieving Higher Energy Efficiency in High-Performance Buildings Using Integrated Practices: A Fuzzy Set- Qualitative Comparative Analysis Approach
Champika Liyanage and Villalba-Romero (2015)	Felix Measuring Success of PPP Transport Projects: A Cross- Case Analysis of Toll Roads
Verweij, Teisman, and Gerrits (2017)	Implementing Public-Private Partnerships: How Management Responses to Events Produce (Un) Satisfactory Outcomes

Prior to defining team performance, here are some definitions found in the literature review:

- Team performance is defined by the weighted coefficient for each performance index indicator and the quantitative measured scores indicators of each team member's alliance team integration performance index, which are Team leadership, trust and respect, single team focus on project objectives, collective understanding, commitment from project alliance board, creation of a single and collocated alliance team, and free flow communication. (Ibrahim et al., 2015).

- A high-performance team is considered to possess attributes such as continuously exchanging knowledge and insights among different disciplines in addition to project information for enhancing the collective team output. Team characteristics leading to high integration among team members (e.g., information/knowledge exchange, reliance, trust, value-sharing) can be mapped and analyzed mathematically to isolate relationships, and visualize network principles (e.g., dominance, centrality, and egocentricity). (Korkmaz & Singh, 2012).
- The ability of a cross-functional project team to execute a project successfully relies on its ability to integrate the relevant knowledge and skills that are distributed among its members. This integration of the capabilities in the team depends on the way they work together and their interpersonal relationships, such as the degree of trust. (Buvik & Rolfsen, 2015). “The key to favorable group outcomes lies in the interaction between group members” (Scotter, Sillers, & Reņģe, 2011).
- “Team performance usually refers to group effectiveness, which can be evaluated in terms of three criteria: productive output, personal need satisfaction and capacity for future cooperation” (Li et al., 2015).
- “Team output refers to team outcomes associated with productivity, performance, as well as capability of team members to continue the work cooperatively” (Juhász, 2010). It is also important, at this point, to define team performance.

Team performance in this research was defined using multiple sources and adapted to include personality and team criteria. The combination resulted in the following team performance definition:

Measures associated with team members such as personality characteristics and team criteria that leads directly or indirectly to the success of the construction project (Buvik & Rolfsen, 2015; Ibrahim et al., 2015; Juhász, 2010; Korkmaz & Singh, 2012; Li et al., 2015; Scotter et al., 2011).

Team performance is different from project performance or success because project performance is attached to project variables such as cost, time, quality of work, planning, or overall project objectives, which is not necessarily linked to team performance (Cooke-Davies, 2002). Team performance ensures that project variables are met to successfully achieve project goals. Some of the common attributes are member satisfaction, shared values/goals/culture, commitment and responsibility, communication and information sharing, and trust and respect (Albanese, 1994; Barry et al., 1997; Spatz, 2000; Kumaraswamy et al., 2005; Asmar, Hanna, & Chang, 2009; Korkmaz et al., 2012; Ibrahim et al., 2015; Rotimi, Lambers, & Zaeri, 2015; Franz et al., 2016; Harper, Molenaar, & Cannon, 2016). Furthermore, project team members usually do not have a contract agreement between the principal stakeholders of the construction project (owner, prime contractor, and designer) (Albanese, 1994). However, many construction projects are dependent on the successful interaction of all team members. For example, high team performance can be present in the project and still obtain low project success due to external risky factors, such as unforeseen events or project conditions, weather conditions, change orders, change of scope, change in management procedures, and safety issues, to mention a few. This research relies on the idea that high team performance should minimize some of these risky factors, to prevent the complete failure of a project.

3.2 Research Questions and Hypothesis

Research Questions

Q1 - Which personality traits can influence team performance?

The first question is raised to identify and determine the specific personality traits that have the most influence on team performance. Based on the literature and the meta-analysis conducted, the personality characteristics of CO, EX, and AG are the traits mostly used to measure team performance, and most influential for predicting team performance. It was also observed in the literature that studies refer to CO as the ideal trait in predicting team performance. It was also supported in the meta-analysis that CO produced the highest *r*-values for team ($r = 0.208$) and individual setting ($r = 0.232$), as shown in Table 3.2. The Pearson *r*-values measure the strength and direction of the relationship between two quantitative variables (Field, 2018). Larger *r*-values indicate a stronger relationship between the variables (Field, 2018). Based on the findings, selecting the SFPQ, CO, EX, and AG are the primary traits from which statement items will be selected. The literature review and the meta-analysis clearly indicate that NE does not positively influence team performance, and it is detrimental to the team. However, NE will be part of the SFPQ to recognize if there are any team members who might score high on NE, which could give an opportunity to understand how negative emotions might influence team performance on construction projects. OP will also be part of the SFPQ test because the literature review and the meta-analysis suggest that at least one team member high on OP should be part of the team. High scores on OP will increase a team's ability to capture the creativity and be innovative in finding solutions to a problem (O'Neill & Allen, 2010). Juhász (2010) suggested that OP can also assist in developing team-oriented skills necessary for decision-making and communication.

Q2 - How do personality traits influence team performance?

Project teams encounter various opportunities for interactions with other domain experts in different environment settings, which could affect the way they behave. Therefore, different personality characteristics become implications when interacting in social environments where personality characteristics are the elements of the interaction (Sarason & Holzman, 1999).

These interactions and each person's personality characteristics influence team performance to be positive or negative. CO influences team performance, as team members are more detail oriented and volunteer in task-focused activities, which helps in the understanding of the task requirements and team members' responsibilities (Guchait et al., 2010). EX influences team performance, as team members are more interactive with others, which make them sociable, and like to resolve issues as a team with constructive resolutions (Bradley et al., 2012). AG influences team performance, as team members are more cooperative, trusting, honest, supportive, and sympathetic to one another (Bradley et al., 2012; Chow et al., 2005; Driskell et al., 2006; O'Neill & Allen, 2010). High level of NE negatively influences team performance, as team members are more inclined to be upset, distressed, irritable, hostile, insecure, and nervous. Furthermore, team members high on NE are not likely to excel in team settings; they tend to blame others for their mistakes, and their negative characteristics are likely to spread to other team members (Driskell et al., 2006). OP influences team performance, as team members are more inclined to innovative solutions or approaches to complicated issues (O'Neill & Allen, 2010). Team members with low levels of OP will tend not to adjust to changes in the project (Driskell et al., 2006).

The meta-analysis in this research concluded that personality influences team performance and that the mean correlation and heterogeneity percentage vary depending on the kind of sample size being utilized for analysis (see Table 3.2). These results suggest that when considering team performance based on a leader of the team, the mean correlation will be lower for those representing a more common correlation among all team members (less diversity). However, when considering all individuals on a team, there is an increase in the heterogeneity percentage, which suggests that there is more diversity in the team and team members do not share a common correlation value. At this point, this is a preliminary finding that will be confirmed when completing the case studies.

Table 3.2. Random Effect Model (k= 33) Teams

Personality Trait	Teams		Individuals	
	I^2	Q p-value	I^2	Q p-value
EX	50.21%	0.0014*	90.41%	< 0.0001*
AG	45.41%	0.0080*	91.60%	< 0.0001*

Table 3.2 Continued.

Personality Trait	Teams		Individuals	
	I^2	Q p-value	I2	Q p-value
CO	19.37%	0.3268	83.61%	< 0.0001*
NE	6.13%	0.6877	81.62%	< 0.0001*
OP	0.00%	0.9152	80.16%	< 0.0001*

Note: * Significant < 0.05

It was also observed the effect size or mean correlation for each personality trait was also influenced by sample size. A lower mean correlation was observed when utilizing the team sample size, as shown in Table 3.3. However, considering each member of the team for the sample size individually, the mean correlation increased. Using this finding from the meta-analysis, once the case studies are completed, the researcher can assess if sample size influences effect size. The effect size refers to the estimated measurement of the relationship between the variables being considered. Cohen (1988) categorizes effect size into small, medium, and large. If the effect size is large, it is possible to detect it with smaller sample sizes, while a smaller effect size will necessitate larger sample sizes.

Table 3.3. Transformation of Fisher's z to Pearson's r

Personality Trait	N = Teams		N = Individual		
	Estimate	SE	Estimate	SE	Diff.
EX	0.162	0.0353	0.185	0.0327	0.023
AG	0.172	0.0336	0.163	0.0349	0.009
CO	0.208	0.0268	0.232	0.0253	0.024
NE	0.020	0.0241	0.033	0.0239	0.013
OP	0.150	0.0228	0.147	0.0231	0.003

Q3 - What personality traits influence team performance on construction projects? Question three will be answered with the data collected from the actual projects employed as case studies to determine if the personality trait found in the literature review can predict team performance in a construction project setting. This research uses the data collected from the selected construction projects and the personality test administered to project team members, to create an initial assessment of the construction team before construction starts or in the initial stages of construction. Later, the researcher compares the initial assessment with the results at the completion of the project to observe differences and determine the level of accuracy. There are the four steps proposed to answer Q3:

1. First, determine the personality type for each of the key team members by administering the SFPQ, obtain initial team performance level (utilizing team criteria), conduct QCA analysis, determine the initial status of the teams, and create a prediction of team performance based on the mean correlation obtained from the literature review.
2. Second, during the construction phase, qualitative data from observations is going to be used to internally to help validate the results.
3. Third, a second SFPQ will be administered to the same key team members at the end of the project to cross-validate the original results and confirm the consistency and validity of their personality measures. The qualitative data collected during the construction of the project will assist in validating if personality traits do influence team performance.
4. Fourth, the QCA will be conducted, and the results should determine which conditions/variables (personality traits and team criteria) predicts team performance. It should also assist in answering research question three regarding personality but in relation to the construction industry.

Conducting interviews and supplemental analysis such as nominal regression analysis, principal component analysis, and hierarchal analysis regression should assist in validating QCA results. The RStudio (RS) statistical software will be used to conduct the necessary statistical analyses, by utilizing the *Psych package* developed by Revelle (2017), to evaluate personality and team performance questionnaires, and the *QCApro and QCA packages* by

Thiem et al., 2018 and Thiem & Dusa, 2013, respectively. Each package is explained in the data analysis section in this chapter.

Q4 - How accurately can personality traits and team criteria influence team performance on construction projects?

The objective of question four is to demonstrate that team performance prediction is possible by utilizing personality traits and team criteria using the measuring tools in this research (personality and team performance questionnaires). The analysis results from the collected data are then compared to the interviews that will be conducted in the case studies, to determine how accurate the results are and, at the same time, establish face validity of the results. The result will be shared with construction experts and psychologists who will assist in discussing and evaluating the results. The construction experts include professionals that the researcher previously worked with, the research experts in construction, and a psychologist with experience in team personality psychometric evaluation. This process will serve as an external validity test to strengthen the results, to find more opinions on future research ideas. Finally, utilizing supplemental analysis procedures and the interviews will assist in answering research question four by demonstrating that similar results could be obtained with other analysis procedures. The interviews will assist in demonstrating the accuracy and face validity of the QCA results.

3.3 Hypothesis

Research questions three and four remain to be answered; the purpose of this chapter is to set analysis procedures to answer them. The following hypothesis will assist in answering research question three:

- Hypothesis 1 (Necessary Conditions) - Personality traits (as a personality measuring tool) act as functional equivalents to team criteria, in providing the necessary personality levels required for high team performance in construction projects.

- Hypothesis 2 (Sufficiency) - The combined presence of at least three personality traits (EX, CO, and AG) and team criteria is linked to high team performance in construction projects.

Question four of this research (Q4) will be answered by assessing and comparing the qualitative data (interviews) with the quantitative data (questionnaires). The collection of interviews from the case studies assisted the researcher to access the accuracy of the model and to establish face validity of the findings.

3.4 Research Design

The data needed for this research will be collected from real construction projects. This means that project team participants will need to be observed during the construction phase of a project to obtain the necessary data that can be used for analysis, validity, and reliability purposes. The observations' main goal will be to collect participants' interactions, collaboration level, willingness to perform, and the level of trust that exists; these factors aid or harm team performance. Therefore, it is proposed to use an ethnography-based multiple-case-study approach (Fellows & Liu, 2015; Yin, 2009). Ethnography, also known as field research, is a research method that investigates how humans interact with each other in a setting. The researcher becomes involved in the interactions to understand behaviors and activities better (Fellows & Liu, 2015). For this research, the researcher will become part of the construction site team to observe and understand how personality and team criteria influence team performance.

3.4.1 Case Study Research

The case-study approach is helpful in acquiring detailed data for the BFF traits, to analyze how these personality traits influence the performance of the project team (Fellows & Liu, 2015), in which the purpose will be to lock theoretical validity to support the forecasting model. Case studies will also assist in obtaining a more detailed result to the reasons how personality traits potentially influence team performance, especially in the construction industry. Currently, the literature review provided evidence on how personality traits influence teams in other industries, but there is an unclear understanding of how personality traits could be a factor in predicting team performance on construction projects. Since there are previous limited investigations related to personality traits and construction team performance, case studies are a viable research approach.

Ethnography will allow the researcher to encompass project team situations by becoming part of the project culture, to observe how team members interact with one another during the construction phase. A qualitative approach will be implemented during the construction phase to collect relevant documentation during the field observations necessary for analysis, validity, and reliability (Fellows & Liu, 2015). A case study protocol was created to warrant the efficiency of the data collected and ensure that the participants' privacy is protected.

Figure 3.1 details the research sequence, which connects the empirical data with the research questions (Yin, 2009). Personality is the assortment of characteristics or qualities that shape a person's character (Merriam-Webster, 2017). The personality method is a process that pursues to describe and understand the distinct characteristics of human behaviors. The variability of how humans think, perceive, learn, and emote in various environments such as personal life and professional life (Sarason & Holzman, 1999) is what this research focuses on. Therefore, the unit of analysis in this research is the team member personality traits and how these personalities and differences in personalities might influence team performance in the construction environment.

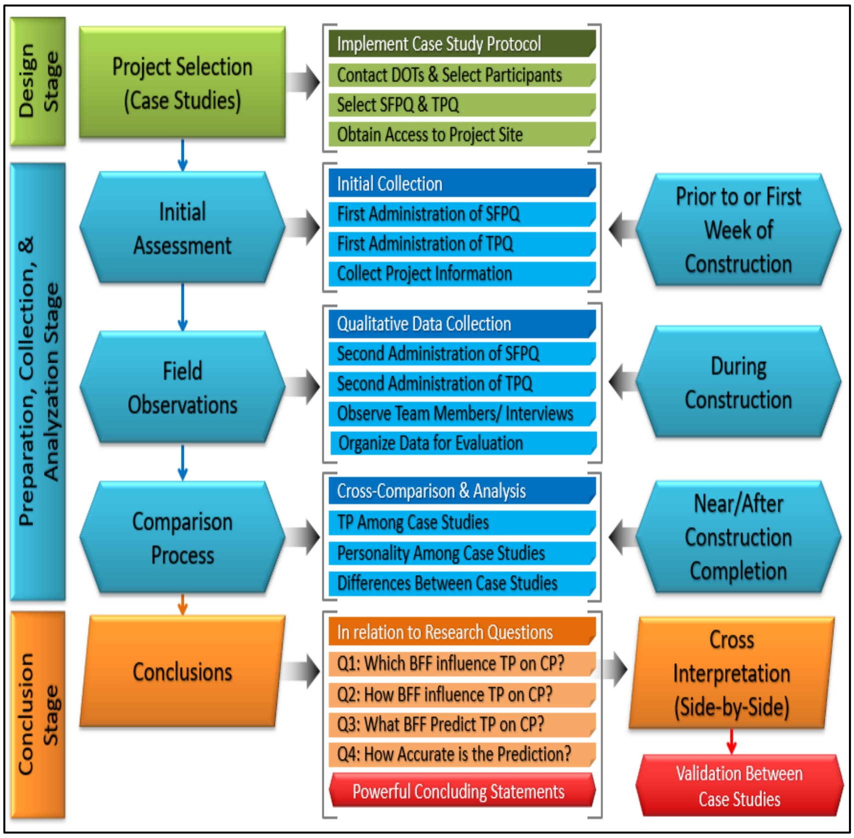

Figure 3.1. Case Study Design and Methodology (DOT = Department of Transportation, SFPQ = Short TP = Team Performance & CP = Construction Projects)

3.4.2 Target Construction Projects and Participants

Former colleagues and network connections from departments of transport (DOTs) in Florida, Alabama, Louisiana, Virginia, and Mississippi are potential sources to conduct case studies research for this project. The goal is to conduct the case studies with at least two DOT projects. See Table 3.4 for possible DOT agencies and possible participants. The researcher will also reach out to other organizations such as the Associated General Contractors (AGC) and Associated Builders and Contractors (ABC) for possible vertical construction projects.

Table 3.4. Possible Locations and Participants

Target Locations		
DOT Agency	**Location**	**Title**
FDOT (Chipley District Office)	Chipley, FL	District Secretary
ALDOT (Administrative Office)	Montgomery, AL	Transportation Director
MDOT (District 6 Office)	Hattiesburg, MS	District Engineer
LaDOTD	Baton Rouge, LA	Project Development Division Chief
VDOT	Richmond, VA	State Construction Engineer

Table 3.4 Continued.

Team Member Participants	
Title	**Team**
Project Manager	Construction
Superintendent	Construction
Quality Control Manager	Construction
Foreman	Construction
Inspector	Owner
Quality Assurance Manager	Owner
Consultant	Owner
Engineer/Architect	Design

In terms of duration, to reduce the time needed to conduct the case studies, potential case study projects ideally need to be about three to six months in duration to allow the researcher to observe the entirety of the construction phase, from mobilization to substantial completion. As for location, ideally, since the researcher will be conducting the case studies alone, securing projects that are close to each other would allow the researcher to conduct the case studies simultaneously. The projects closer to the researcher's location will reduce travel time to the sites; the states listed in Table 3.4 are ideal locations.

3.5 Selection of the Personality Questionnaire

The selection of the personality questionnaire will help answer Research Question Three. The personality questionnaire aids the researcher in determining the levels of personality traits among the team members of the selected construction project case studies. As previously mentioned in Chapter One, under the IPIP method section, the data collection depends on developing or selecting a SFPQ that has the same quality as the parent IPIP method long-form personality test (LFPT). The IPIP method has over 3,000 relevant questionnaire items and 250 scales available to the public to assist in personality research. The IPIP items consist of short phrases, such as "Feel comfortable around people," and each phrase is rated using a 5-point Likert scale (Goldberg et al., 2006; Goldberg, 1999). Due to the size of the LFPT from the IPIP method, it is necessary to either develop the SFPQ or select one from the IPIP database. The IPIP database has several personality questionnaires researched and tested rigorously with extensive population samples over a long period. Therefore, the personality questionnaire needed for the case studies will be selected from the IPIP database. The advantage of choosing a questionnaire from the IPIP database is that it contains all the validity measures such as alphas and average correlations needed to validate the findings from the case studies. Additionally, it has all the references supporting the validity of the personality questionnaires. The selected SFPQ will be submitted to the LSU Institutional Review Board (IRB) for review and approval; it will be pilot tested and approved by a professional psychologist before it is implemented in the field.

Many researchers have utilized the IPIP to understand personality differences in a variety of scenarios in which humans interact. At the time of this study, there are a total of 706 publications that have used the IPIP database to conduct investigations (See http://ipip.ori.org/newPublications.htm for a list of the publications). From the meta-analysis, it was found that the majority of the studies used the IPIP and/or the NEO-FFI (NEO Five-Factor-Inventory) to measure personality and its influence on team performance. Finally, since the IPIP rights have been made available to the public for no extra charge, the IPIP database is suitable for this research. The IPIP only requires researchers to reference the work properly.

Personality involves a complex interaction of factors; it ranges from a person's personal experiences, the environment in which the person interacts, the situation in which the person is in, and the behaviors of others (Hellriegel & Slocum, 2004), but a person is expected to behave accordingly despite the factors. The SFPQ will assist this research in determining the levels of personality trait in construction projects. The SFPQ will instruct the members to answer the questions as they currently feel, not as they wish to feel, and to rate themselves honestly. The scoring of the SFPQ will be conducted using a Five-point Liker scale from (1) "Very Inaccurate", (2) Moderately Inaccurate", (3) "Neither Accurate nor Inaccurate", (4) "Moderately Accurate", and (5) "Very Accurate". The SFPQ will consist of 50 questionnaire items, with 10 questionnaire items per personality trait. Table 3.5 details the personality trait spectrum that describes the lows and high of each personality trait in a team-setting environment. For the individual spectrum, please see Table 1.1 in Chapter 1.

Table 3.5. Personality Trait Influence Spectrum for a Team Setting Environment

Low Spectrum **Likert Scale of 1**	**Personality Trait**	**High Spectrum** **Likert Scale of 5**
Ineffective, lack of goals, lack of cooperation and organization, counterproductive behavior, and low job satisfaction	**Conscientiousness**	Engaged in goals or planning goals, perform tasks in detail, enthusiastic with team members, high levels of organization, higher job satisfaction, and higher levels of productive behavior
Reduced team effort, lack of response to team members, focus only on individual efforts, higher competition among team members, and more arguments	**Agreeableness**	High vitality, concern for team success over personal, trust among team members, better conflict resolution, open communication, flexibility to changes, team members work well with each other, and less competition among team members
Team cohesiveness, effective decision making, high conflict management, high levels of cooperation, more open communication, emotionally stable during discussions, and a peaceful team environment	**Neuroticism**	Reduced team cohesiveness, disruption of task coordination due to ill-tempered, high levels of disagreement, anti-social team environment, and higher impulsive behavior which hurts communication
No creative solutions, sticks to established methods, struggle to resolve issues, team feels threatened to new methods, avoid open discussion, and not flexible to changes which affects adaptation	**Open to Experience**	Generation of noble solutions, do not avoid conflict & approach conflict with collaboration, high flexibility to changes, higher levels of adaptation, and promotes open discussions
Ineffective, reduced team cohesiveness, low levels of communication, and low levels of coordination	**Extraversion**	Team cohesiveness, higher communication, and higher coordination

Source: See Appendix I for a list of studies used to create this table.

3.5.1 50-Item Personality Questionnaire

Through experience, construction team members are typically busy when at the construction site and do not like to deviate from their responsibilities due to reprimand and loss of time. Therefore, the personality questionnaire could not be lengthy. Many personality questionnaires are lengthy, as the questionnaire attempts to capture all aspects of personality to help researchers with reliability and validity. Thus, many investigations seek to shorten personality tests to save time and cost (Smith et al., 2001). However, shorter personality questionnaires may lose validity when reducing the length. Smith et al. (2001) suggested that short questionnaires should be proven reliable and validated. The selected SFPQ must be one that provides the alphas and average correlation values, thus establishing reliability. Many researchers make mistakes in assuming the SFPQ will carry the same reliability and validity as the IPIP and that statistical validity is not necessary. This is an error; the researchers are encouraged to use a validity process of the SFPQ as part of the analysis process (Donnellan et al., 2006). Therefore, to avoid validity issues, this research will perform the necessary reliability and validity measures of the case studies' SFPQ and compare the values to the IPIP's archived validity values.

External validity will be established in two ways. The first will be to use construction experts, researchers in construction, and psychologists to review the findings. The second will be to conduct a cross-case analysis to verify the findings. Establishing external validity with experts will consist of sharing the findings of the research with them. The comments received from the experts will be documented and carefully reviewed so that any necessary adjustments can be made to the research.

3.6 Selection of the Team Performance Questionnaire (TPQ)

The team performance questionnaire (TPQ) will assist in answering Research Question Three in conjunction with the personality questionnaire by measuring team performance (See appendix XIX). The team performance questionnaire's objective is to measure the intra-group interactions and use them to determine which personality trait might predict team performance. The findings will also be used to assess what has been found in the meta-analysis and, consequently, determine if there is a significant difference between the general population and the construction industry.

There is an abundance of information that can be obtained from a construction project site. The purpose of this research is to focus on data that is relevant to team performance based on team members' interactions. The team performance questionnaire will measure team member interactions, linked to team performance, by having team members rate the team and its members. The questionnaire items will come from a similar study used in transportation construction projects founded by the Louisiana Board of Regents and from the literature review.

Louisiana Board of Regents funded a study titled “Advancement of Integration and Partnering on Construction Projects,” whose objective was to study the correlation between project team integration and project cost and schedule performance using relational contracting norms (Silva & Harper, 2018). The study collected data from publicly funded transportation projects using a questionnaire to measure team member level of integration. The total project team integration was measured using a series of questions based on relational contracting. The rating system used was a 5-point Likert scale from 1 “Strongly Disagree” to 5 “Strongly Agree”; they were summed to produce a total project team integration rating (Silva & Harper, 2018). The study provided initial evidence that integrated project team members who collaborate, cooperate, trust others, and are willing to work together suggest a higher probability of success during the construction phase. Therefore, the researcher will use several questions from five variables of the Louisiana Board of Regents study and combined them with the common attributes found in the literature review for successful teams. Table 3.6 details the variables used from the Louisiana Board of Regents study for the team performance questionnaire.

Table 3.6. Relational Contracting Norms from Louisiana Board of Regents Study

Relational Contracting Norms	Adapted to this Research
Role of Integrity Behavior	Team Member Satisfaction
Flexibility Behavior	Team Member Satisfaction, Commitment & Responsibility
Reciprocity Behavior	Shared Values/Goals/Culture
Reliance & Expectations Behavior	Communication & Information Sharing
Contractual Solidarity Behavior	Trust & Respect

The literature provided a great list of the common attributes (questionnaire items) that need to be present for teams to be effective, which are detailed in Table 3.7. Nineteen common attributes were found in the studies, which will result in a very large number of combinations of conditions for QCA analysis. Therefore, the common attributes were grouped based on their definition and application. From the grouping process, 13 common attributes were produced. This led the researcher to view the frequency of the common attributes in the studies. The relative frequency produced five common attributes with a relative frequency higher than 10% weight. These five common attributes definition are as follow and detailed in table 3.8:

1. Member Satisfaction (MS): The ability of a team member to effectively meet team expectations such as the combination of collaboration, cooperation, and leadership, which are attributes that are built from personal bonds between team members; they also translate to team cohesiveness (Goleman, 1998; Hackman, 1973; Hare, 1976; Hogg, 1992; Zelst, 1952).
    a. Collaboration: High collaboration among team members leads to increased efficiencies related to staying on track, meeting due dates, and improving team morale (Spatz, 2000b).
    b. Cooperation: The ability for team members to provide the necessary skills or knowledge that enables team performance when working alongside other team members (Albanese, 1994; Harper et al., 2016; Rotimi et al., 2015; Spatz, 2000).
    c. Leadership: The level of influence of a team member or members that shapes the team's direction, purpose, goals, communication, and enthusiasm ensuring the success of the team (Albanese, 1994; Barry et al., 1997; Ibrahim et al., 2015; Korkmaz et al., 2012; Spatz, 2000).
2. Shared Values/Goals/Culture (SVGC): The ability of team members to pursue common values such as trust, respect, honesty, and communication. It also includes the ability to share common goals, which helps to ensure acceptable team performance (Albanese, 1994; Korkmaz et al., 2012; Kumaraswamy et al., 2005; Spatz, 2000).
3. Commitment and Responsibility (CR): The ability of team members dedicated to the objectives of the team and the project at hand. It also encompasses the willingness and

responsibility of team members to be dedicated to all the aspects mentioned above, to ensure team performance (Albanese, 1994; Barry et al., 1997; Franz et al., 2016; Harper et al., 2016; Ibrahim et al., 2015; Spatz, 2000).

4. Communication and Information Sharing (CI): The exchange of relevant information and exchange of ideas between team members (Albanese, 1994; Barry et al., 1997; Ibrahim et al., 2015; Franz et al., 2016; Harper et al., 2016; Korkmaz et al., 2012; Kumaraswamy et al., 2005; Rotimi et al., 2015; Spatz, 2000).
5. Trust and Respect (TR): The level of reliability a team member has acquired from other team members. It can encompass other aspects such as commitment, competence, communication, and collaboration. Respect refers to the level of admiration a team member has for others due to skills, qualities, or achievements (Albanese, 1994; Barry et al., 1997; Harper et al., 2016; Ibrahim et al., 2015; Korkmaz et al., 2012; Kumaraswamy et al., 2005; Rotimi et al., 2015; Spatz, 2000).

Table 3.7. Common Attributes in the Literature Review Related to Team Performance

Source	Attributes
Albanese, (1994)	1. Shared goals 2. Trust 3. Leadership 4. Shared commitment 5. Project culture 6. Reinforcement of project culture 7. Open communication 8. Cooperation 9. Shared accountability 10. Pride in their team
Barry and Steward (1997)	1. Trust 2. Communication 3. Leadership 4. Commitment
Spatz (2000a)	1. Mutual interest, goals, & strategies 2. Shared values 3. Individual Responsibilities 4. Collaboration 5. Cooperation 6. Agreed behaviors 7. Shared leadership 8. Continual improvement 9. Trust 10. Communication 11. Commitment

Table 3.7 Continued.

Source	Attributes
Kumaraswamy et al. (2005)	1. Trust 2. Open communication 3. Commitment 4. The relationship between team members 5. Culture or shared values
Asmar et al. (2009)	1. Team capabilities 2. Cultural fit 3. Efficiency 4. Effectiveness 5. Method of approach
Korkmaz and Singh (2012)	1. Information/knowledge exchange 2. Leadership 3. Reliance 4. Trust 5. Communication 6. Value Sharing (openness, integrity, respect, flexibility, teamwork, responsibility, honesty, and timeliness).
Harper et al. (2016)	1. Role integrity – the strength of relationships 2. Reciprocity – joint responsibility & mutuality 3. Flexibility – Adaptability to unforeseen events 4. Propriety of means – Fulfill commitments 5. Reliance & Expectations – Adhere to commitments 6. Restraint of power – Refrain from exploiting each other 7. Contractual Solidarity – Success through combined efforts 8. Harmonization of conflict – Mutual cooperation during conflicts
Ibrahim et al. (2015)	1. Team Leadership 2. Trust & Respect 3. Collective understanding 4. Commitment from team 5. Leadership 6. Free flow of information 7. Communication
Franz et al. (2016)	1. Delivery method 2. Team integration 3. Cohesion 4. Turnover experience 5. Facility quality 6. Communication
Rotimi et al. (2015)	1. Trust 2. Communication 3. Cooperation 4. Information sharing

Table 3.8. Frequency of Common Attributes in the Team Criteria Selected Studies

Grouped Common Attributes	Frequency	Relative Frequency
Member Satisfaction (6)	18	0.24
Shared Goals/Values/Culture (7)	12	0.16
Commitment/Responsibility (8)	11	0.15
Communication/Information Sharing (9)	11	0.15
Trust & Respect (10)	10	0.13
Management Approach	3	0.04
Flexibility	2	0.03
Honesty	2	0.03
Efficiency	2	0.03
Continual improvement	1	0.01
Pride	1	0.01
Experience	1	0.01
Timeliness	1	0.01

The construction industry incorporates labor-intensive commerce and requires team members to work and manage various people with different skills, knowledge, and personalities to achieve project success. Expanding construction complexity and considerable project requirements force construction team members to operate by valuing team integration, collaboration, and cooperation. These aspects are necessary for team performance and ultimately influencing project success. This team performance construct was defined interactively based on empirical findings within the personality and team performance context. The measures needed to score team performance were accessed using the literature review and a previously conducted study with the Louisiana Board of Regents. The value of team members working in cohesion and collaboration during the construction phase of a project can potentially dictate a level of team performance that can only be achieved depending on the level of their willingness to work together, which reflects personality.

The selection process of the TPQ concluded with the selection of five common attributes and four variables from the Louisiana Board of Regents project for a total of 38 questions. For clarity, the common attributes and the Louisiana Board of Regents project's variables will be referred to as conditions, which is later explained in the analysis section why the name condition is used. The questions used for each team performance condition will be referred to as items. To add robustness to the research, the researcher also added the following demographic questions to the TPQ: 1) organization's role in this project, 2) team member's role with the organization, 3) team member's years of experience in the construction industry, 4) team member's working years with the organization, 5) team member's years with current role/position, 6) team member's age range, and 7) team member's level of education. The demographic information will help to understand how the population characteristics might play a role in personality and team performance.

As part of the TPQ, the team members will rate the team, which will give the researcher a score for each condition. The researcher will use the condition scores to rate the intra-group interaction, which will be the team performance score. The team performance score will be used to analyze if personality traits influence team performance or not. Using previous research on how to interpret team performance, Table 3.9 details a percentile score ranging from “Low Team Performance” to “High Team Performance,” hence aiding in the interpretation of team performance scores (Barry & Stewart, 1997; Fletcher et al., 2004; Werner & Lester, 2001).

Table 3.9. Team Performance Score Interpretation (Barry & Stewart, 1997; Fletcher et al., 2004; Hellriegel & Slocum, 2004; Werner & Lester, 2001)

Interpretation	**Percentile Score**
Team performance is consistently high, suggesting considerable higher levels of success (exceeding expectations).	75 to 100
Team performance is satisfactory but could be improved, suggesting moderate levels of success.	26 to 74
Team performance needs considerable improvement, suggesting lower levels of success (not meeting expectations and cause for concern).	0 to 25

3.7 Data Collection

The data collection plan is a critical procedure in the research of measuring the results and answering the research questions. Developing a process of organizing, coding, and measuring data can help the research recognize the effectiveness and value of the data collected (Creswell, 2014; Yin, 2009). The data collection process for this research will focus on conducting observations and collecting relevant documents that explain or clarify how personality differences influence team performance. Therefore, a time series convergent parallel mixed-method design is adequate to collect a diversity of quantitative and qualitative information, to carry out the necessary evaluations. A convergent parallel design means that the researcher performs the quantitative and qualitative elements simultaneously, weighs the methods equally, analyzes the two components separately, and interprets the findings together (Creswell & Clark, 2011). The convergent mixed design consists of gathering qualitative and quantitative information separately, analyzing each separately, and cross-interpretations of the two data types to find normalness or variances. The key point here is that both types of data will offer additional evidence. When compared together, they provide an interpretation that potentially explains the influence that personality traits have on construction team performance. Figure 3.2 demonstrates a detailed sequence of the data collection plan (Creswell, 2014). The time series refers to when the data will be collected during the case study. See Table 3.10 for a detailed view of the data type and associated collection sequence.

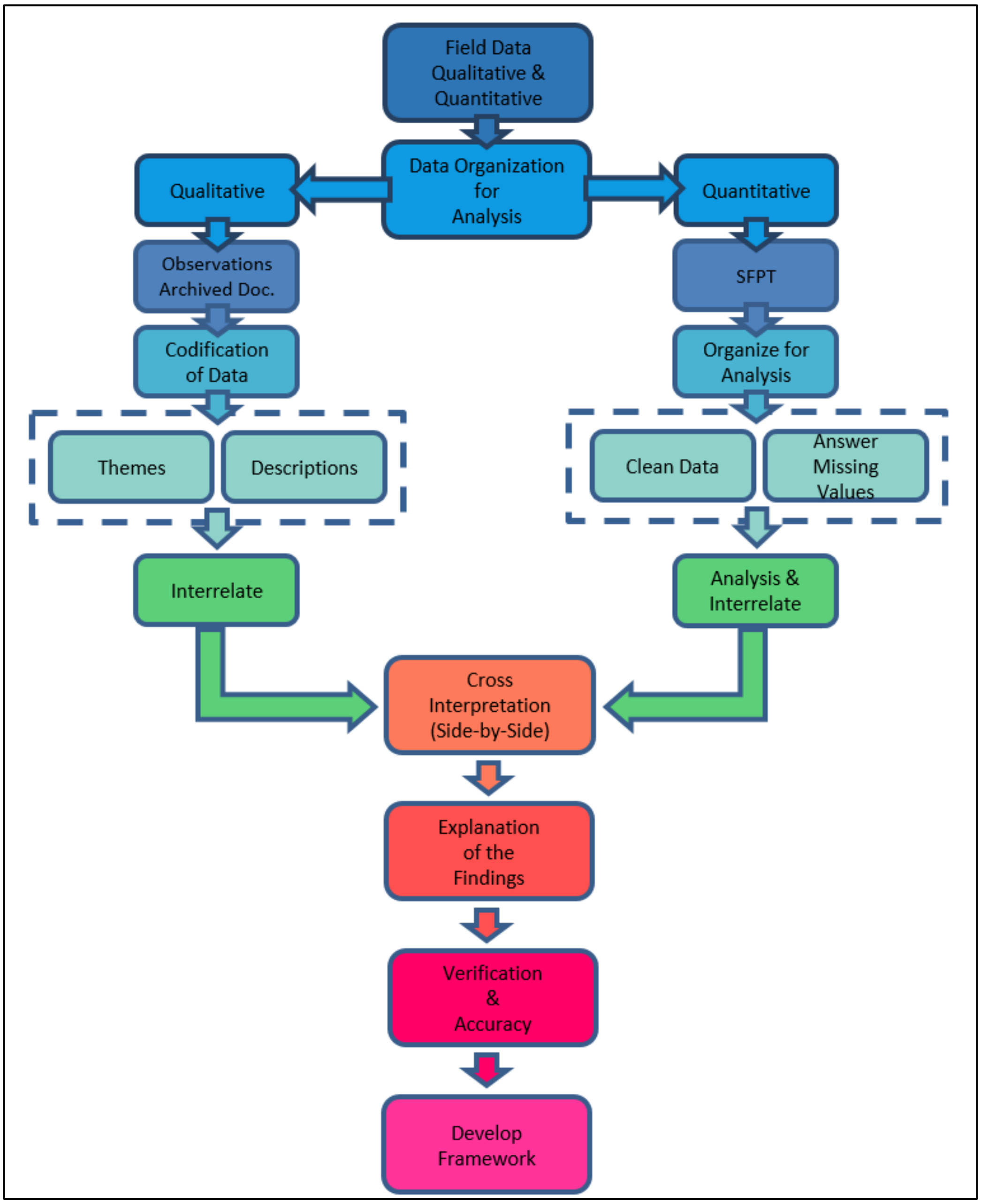

Figure 3.2. Data Collection and Analysis Sequence

Table 3.10. Qualitative and Quantitative Data Collection Forms

Measure	Data Type	Collection Method	When to be Collected?
Initial SFPQ & Team Performance	Quantitative	Questionnaire	Start of the construction phase
Project Data	Quantitative/Qualitative	Archived Records	During the construction phase
Team Member Interviews	Qualitative	Interviews	During the construction phase
Final SFPQ & Team Performance	Quantitative	Questionnaire	Near completion of construction

3.7.1 Personality Questionnaire (IPIP 50 Item)

The SFPQ is the 50-item personality questionnaire (See appendix XVIII) obtained from the IPIP database, developed by Goldberg (1992) using the big five personality trait. The SFPQ will be used in this research to measure the team members' personality trait levels, and the questionnaire will be developed and distributed electronically using Qualtrics to collect the responses. Initially, the researcher was to be on-site distributing the questionnaire with a computer tablet. However, due to COVID-19, the researcher had to create and send links to SFPQ through emails. Email reminders are also sent bi-weekly to ensure the participants complete the questionnaire. The researcher will use the project engineer (PE) from each project as the primary contact to encourage team members to complete the questionnaire. The researcher will send emails to the PE, asking them to remind team members about the personality questionnaire. The SFPQ will be administered twice for all case studies, at the beginning of the project and at the end of the project. By doing this, the researcher can test the questionnaire to establish validity and reliability. The SFPQ consists of 50 questions with 27 positive-keyed (denoted as "1") and 23 negative-keyed questions (denoted as "-1"). Table 3.11 details the SFPQ with original reliability measures from the IPIP database and explains how the questions are distributed between the five personality traits.

Since the personality assessments produce ration scale measurement (Goldberg et al., 2006; Goldberg, 1999; Miller & Lovler, 2016), it cannot be inferred how much of the personality trait a team member has. The SFPQ scores are only relative measures that suggest that a team member is within a percentage of the sample population, for example, more extraverted than the rest of the team members. In other words, it states how far from the sample mean is the team member located. Therefore, the authors used sample mean and standard deviation to report the scores as percentiles.

Score interpretation for each trait were 1) low 0.0 to 0.31 percentile, 2) average 0.32 to 0.69 percentile, and 3) high 0.70 to 1.0 percentile. This sets the scores within one-half the standard deviation of sample means as the average score. Any scores below or above the sample mean were interpreted as low or high, respectively. With a normal distributed data set, team members scores would range in approximately 38% as average, about 31% as low, and 31% as high (Goldberg et al., 2006; Goldberg, 1999; Miller & Lovler, 2016). The percentile scores were used for the QCA procedure

Table 3.11. SFPQ Questions and Reliability Measures (Goldberg, 1992)

No.	Item	Keyed	Traits	Mean Item Intercorrelation	Coefficient Alpha
1	Am the life of the party	1	Extraversion	0.40	0.87
2	Don't talk a lot	-1			
3	Feel comfortable around people	1			
4	Keep in the background	-1			
5	Start conversations	1			
6	Have little to say	-1			
7	Talk to a lot of different people at parties	1			
8	Don't like to draw attention to myself	-1			
9	Don't mind being the center of attention	1			
10	Am quiet around strangers	-1			
11	Feel little concern for others	-1	Agreeableness	0.31	0.82
12	Am interested in people	1			
13	Insult people	-1			
14	Sympathize with others' feelings	1			
15	Am not interested in other people's problems	-1			
16	Have a soft heart	1			
17	Am not really interested in others	-1			
18	Take time out for others	1			
19	Feel others' emotions	1			
20	Make people feel at ease	1			
21	Am always prepared	1	Conscientiousness	0.29	0.79
22	Leave my belongings around	-1			
23	Pay attention to details	1			
24	Make a mess of things	-1			
25	Get chores done right away	1			
26	Often forget to put things back in their proper place	-1			
27	Like order	1			
28	Shirk my duties	-1			
29	Follow a schedule	1			
30	Am exacting in my work	1			
31	Get stressed out easily	-1	Neuroticism	0.38	0.86
32	Am relaxed most of the time	1			
33	Worry about things	-1			
34	Seldom feel blue	1			

Table 3.11 Continued.

No.	Item	Keyed	Traits	Mean Item Intercorrelation	Coefficient Alpha
35	Am easily disturbed	-1			
36	Get upset easily	-1			
37	Change my mood a lot	-1			
38	Have frequent mood swings	-1			
39	Get irritated easily	-1			
40	Often feel blue	-1			
41	Am full of ideas	1	Openness	0.34	0.84
42	Have a rich vocabulary	1			
43	Have difficulty understanding abstract ideas	-1			
44	Have a vivid imagination	1			
45	Am not interested in abstract ideas	-1			
46	Have excellent ideas	1			
47	Do not have a good imagination	-1			
48	Am quick to understand things	1			
49	Use difficult words	1			
50	Spend time reflecting on things	1			

3.7.2 Team Performance Questionnaire (TPQ)

The main objective in using the TPQ is to measure the team performance levels of the construction teams in each case study. The researcher will use Qualtrics as the delivery and collection instrument for the TPQ. Similar to the personality questionnaire, the researcher was to be on-site distributing the questionnaire with a computer tablet. However, due to COVID-19, the researcher will send anonymous links to the questionnaire through emails to the team members. Email reminders are going to be part of the research to ensure the participants complete the questionnaire. Additionally, the researcher will use the PE as the primary contact to encourage team members to complete the questionnaire. Team members are asked to rate the team and team members based on their opinions and experiences about the current construction project they are working. To record the scores, a 5-point Likert Scale was used, in which the rating scale is strongly disagree = 1, disagree = 2, neither agree nor disagree = 3, agree = 4, and strongly agree = 5. The TPQ will be administered twice for all case studies, once at the beginning of the project, and once at the end of the project so that tests can be conducted to establish validity and reliability of the TPQ. Table 3.12 details the TPQ with its 9 conditions, 38 questionnaire items and their respective source.

Table 3.12. TPQ Conditions and Questionnaire Items

No.	Item	Likert Scale	Conditions	Source
1	The team is the right size for the tasks required	1 – 5	TCP	Harper et al. (2016); Hackman (1990)
2	Team members have the expertise required to perform tasks well	1 – 5		
3	The mix of experience and knowledge of team members is appropriate	1 – 5		
4	There are signs that team members are so similar in personality that there is little for them to learn from one another	1 – 5		
5	There are signs that team members are so opposite in personality that they do not communicate well with one another	1 – 5		
6	The team consistently has the right information to complete tasks	1 – 5	TIS	Harper et al. (2016); Hackman (1990)
7	The team shares with one another the information necessary to correct issues in a timely manner	1 – 5		
8	The team has a system to track performance to provide the team with feedback	1 – 5		
9	Team members rely on other team members with more experience	1 – 5		
10	The team works together to control the budget and costs on the project	1 – 5	TPO	Harper et al. (2016); Hackman (1990)
11	The team works together to control the schedule and time changes on the project	1 – 5		
12	The team works together to establish milestones for cost and schedule evaluations	1 – 5		
13	The team works together to address quality deficiencies	1 – 5		
14	The team tracks project quality to ensure issues are corrected in a timely manner	1 – 5		
15	Team members would like to work with the same team members again on another project	1 – 5	TSV	Harper et al. (2016); Hackman (1990)
16	Working as a team helps improve team members' skills to work well with others	1 – 5		
17	Team members offer help to each other to complete tasks	1 – 5	TSV	Harper et al. (2016); Hackman (1990)
18	Team members feel satisfied when working together	1 – 5		
19	Team member has a clear understanding of their own and other's roles and responsibilities	1 – 5	TMS	Harper et al. (2016); Rotimi et al. (2015); Ibrahim et al. (2015); Korkmaz et al. (2012); (Spatz, 2000); Goleman (1998); Barry et al. (1997); Albanese (1994); Hackman (1990); Hare (1976); Zelst (1952); and Salas et al. (2005)
20	The focus of the team member is to successfully complete project goals and objectives	1 – 5		
21	The team member anticipates the ability to make cooperative adjustments to cope with changing circumstances or conditions	1 – 5		
22	The team member was proud that everyone in the team did their best to achieve project goals	1 – 5		
23	The team member is concerned with everyone obtaining successful outcomes	1 – 5	SVGC	Harper et al. (2016); Korkmaz et al. (2012); Kumaraswamy et al. (2005); Spatz (2000); Albanese (1994); Salas et al. (2005)
24	The team member trusts the other team members with their knowledge and abilities	1 – 5		
25	When a difference of opinion occurs, the team member makes an effort to work out the issue internally, respectfully, and jointly with others	1 – 5		
26	The team member respects others and considers other's interests when making decisions	1 – 5		
27	The team member accommodates others when problems or needs arise	1 – 5	CRP	Franz et al. (2016); Harper et al. (2016); Ibrahim et al. (2015); Spatz (2000); Barry et al. (1997); Albanese 1994); Salas et al. (2005)
28	The team member is willing to make changes in work strategies based on changes during construction	1 – 5		
29	The team member is open to modifying agreements and accepting changes when necessary	1 – 5		
30	The team member is willing to give feedback to other team members	1 – 5		
31	The team member is willing to share any necessary project information	1 – 5	CIS	Rotimi et al. (2015); Franz et al. (2016); Harper et al. (2016); Ibrahim et al. (2015); Korkmaz et al. (2012); Kumaraswamy et al. (2005); Spatz (2000); Barry et al. (1997); Albanese 1994); Hackman (1990); Salas et al. (2005)
32	The team member keeps others informed about events or changing conditions that can affect others or the project	1 – 5		
33	the team member assures that all members have received important information	1 – 5		
34	Others can ask the team member for an explanation when questions arise on how to perform tasks as planned	1 – 5		
35	The team member respects others on the project and provides helpful feedback to the team	1 – 5	TRP	Rotimi et al. (2015); Harper et al. (2016); Ibrahim et al. (2015); Korkmaz et al. (2012); Kumaraswamy et al. (2005); Spatz (2000); Barry et al. (1997); Albanese (1994); Salas et al. (2005)
36	The team member could be trusted with their knowledge and experience	1 – 5		
37	The team member on this project is committed to others and to the success of the project	1 – 5		
38	A supportive atmosphere exists for getting work done when working with the team member	1 – 5		

Notes: Team Composition (TCP), Team Access to Information (TIS), Team Productive Output (TPO), Team Survivability (TSV), Team Member Satisfaction (TMS), Shared Values/Goals/Culture (SVGC), Commitment & Responsibility (CRP), Communication & Information Sharing (CIS), and Trust and Respect (TRP)

3.7.3 Field Observations

Initially, the research case study protocol called for conducting field observations of the project team members. However, due to the COVID-19 pandemic that started in March 2020, the field observations had to be removed from this research, as the case studies are conducted in 2020. Construction project management personnel were only permitting essential personnel onto their construction project sites and face-to-face contact was held to a minimum. Through several calls between PEs, the researcher was able to secure some projects and collect the data via emails and the questionnaires administered via Qualtrics. Therefore, this dissertation research's data collection had to rely on the data collected through questionnaires, conducting interviews by phone call, and reviewing project data and information. Behavior and team members' interaction observations were initially going to be recorded during progress meetings and specific daily onsite meetings. The phone interview, despite comprising a small number of participants, provided insightful qualitative information about the team member's interactions. The objective of the phone interview was to find any supportive evidence to the findings from the questionnaires' evaluation, which is critical for internal validity. The interview questions (See appendix XX) used were directed to find supportive evidence to the following statements: 1) joyful working environment, 2) existence of trust, 3) comfortableness with personality, 4) personality influence on team performance, 5) comfortableness with other team members, 6) resolution of tasks and issues, 7) team performance proudness, 8) appreciation of team member's contributions, 9) overall quality of work, and 10) overall project safety. Even though the observations could not be performed, the researcher expects to produce findings during the data analysis and explain the findings in detail, in Chapter Five.

3.7.4 Project Data

- The project data collected will be used to validate the behaviors of the team during the construction phase. Being on-site and understanding what the teams' responsibilities are, there should be a paper trail of events that can potentially impact team performance. Potential project data that the researcher intends to collect includes:

- Meeting information and meeting minutes
- Change orders
- RFIs
- Testing and inspection records
- Submittal logs
- Contract documents
- Progress schedules
- Progress meeting notes
- Any other relevant documents that indicate information on team performance

3.8 Data Analysis

The flexible holistic approach using multiple case studies and combining qualitative and quantitative data leads to understanding of how personality traits influence team performance in a construction project. Since qualitative and quantitative data alone do not produce a meaningful answer to this issue (Creswell & Clark, 2011), combining both data sources is a proper approach in constructing reliable outcomes. Qualitative data comes from the field observations and archived documents, which supplement the quantitative data obtained from the SFPQ and TPQ (Creswell & Clark, 2011).

The combination of both data sources can be analyzed to find correlations between team member interactions on the construction site and personality differences of project team members, with the intention of finding a relation to team performance. The objective of the data analysis is to prove and validate that construction team performance can be predicted with the personality trait of the project team members.

3.8.1 Statistical Analysis Tools

For this study, RS was selected for statistical data analysis, as it offers various statistical packages that have been tested and used by many investigators. Furthermore, RS is an open-source (free to use) statistical analysis software used by many industries and educational agencies worldwide (RStudio, n.d.). In addition, there are a variety of resources and libraries supporting various analyses. The Psych package, a platform built in RS, was specifically created to perform psychometric analysis and score personality tests. Revelle (2017) has created guides with RS codes, which are available for free to conduct psychometric and personality research analysis. The Psych package is a tool primarily for multivariate analysis and scale construction; it utilizes many functions. Some of the functions useful for this research are providing descriptive statistics, scoring personality trait/scales, and scoring the TPQ. After scoring the questionnaires using the Psych package, the scores will be transferred to MS Excel to conduct percentile-ranking scores, which will be used for QCA. The hierarchal analysis regression will be conducted in RS. JMP Pro was also used to conduct the supplemental analysis such as the multinominal logistic regression and principal component analysis. JMP Pro will be used to conduct distribution analysis of the demographic variables such as years of experience, role, education, and age range.

3.8.2 Scoring of the SFPQ and TPQ

To score the SFPQ and TPQ from the raw data, the Psych package in RS uses the "*scoreItems*" command to score the questionnaires, and by default, it reports the average scores for each questionnaire item along with descriptive statistics (Revelle, 2017). The Psych package also includes a report of Cronbach's alpha, Guttman's Lambda 6, the average correlation, the trait/condition intercorrelations, and the questionnaire items by trait/condition correlations (Revelle, 2020). For the scoring process to work, the responses are recorded using a 5-point Likert scale (Goldberg et al., 2006; Goldberg, 1999). Table 3.13 is an example of how the raw data looks along with the five-point scale.

Table 3.13. Example of Raw Data and 5-point Scale

Instruction: How well do the following statement describe your personality?							
Q#	**Item**	**I see myself as someone who…**	**Disagree Strongly**	**Disagree a Little**	**Neither Agree nor Disagree**	**Agree a Little**	**Agree Strongly**
			1	**2**	**3**	**4**	**5**
1	T209	…is emotionally reserved					
2	T371	…is generally trusting of others' motives.					
3	E141	…is relaxed most of the time.					
XX	Q197	…gets started quickly on doing a job.					

Source: IPIP Website. Retrieved from http://ipip.ori.org/AlphabeticalItemList.htm

Scoring of the questionnaires must be completed first, which is necessary to conduct the validation procedure of the SFPQ and the test-retest reliability measure for both questionnaires. Below is the command line example used in RS to conduct the scoring of the questionnaires (See Figure 3.3). The command and procedure will be further detailed in the analysis section of this research.

Command line: > scoreItems (keys, items, totals = TRUE, impute = "median", min=1, max=5, digits=3)

- **Keys:** A list of scoring keys or a matrix or data frame of -1, 0, or 1 weight for each questionnaire item for the personality trait and team performance conditions.
- **Items**: Matrix or data frame of the raw questionnaire item scores.
- **Totals:** If TRUE, it will find total scores. If FALSE (default), it will find average scores.
- **Impute:** Impute = "median" replaces missing values with the item medians. Impute = "mean" replaces values with the mean response. Impute = "none" the subject's scores are based upon the average of the keyed, but non missing scores. Impute = "none" is probably more appropriate for a large number of missing cases.
- **Min:** It May be specified as the minimum item score allowed, else will be calculated from data.
- **Max:** It May be specified as the maximum item score allowed, else will be calculated from data.

Figure 3.3. Command line example used in RStudio to conduct the scoring of the questionnaires source (Revelle, 2017)

3.8.3 Questionnaire Evaluation

Before continuing with the primary analysis procedure, the SFPQ and the TPQ are to be evaluated to ensure the reliability and the precision of the questionnaire scores (Miller &

Lovler, 2016). The evaluation procedure will consist of the following two analysis: 1) The validity method of the SFPQ, and 2) Test-retest for reliability using Pearson product-moment correlation coefficient.

3.8.4 Reliability Procedure of the SFPQ

If questionnaires items are selected from the IPIP database, the researcher needs to obtain reliability measure for the SFPQ selected from the IPIP during the pilot test. Additionally, as a part of the reliability process, the same SFPQ has to be administered for a second time at the completion of each case study project, to access the reliability of the first administered SFPQ at the beginning of the case study project (Donnellan, Oswald, Baird, & Lucas, 2006; Goldberg et al., 2006; Goldberg, 1999; Smith et al., 2000). However, this research utilized an existing 50-item personality questionnaire created by Goldberg (1992) as the SFPQ to be used. For more details on the 50-item questionnaire, see the "Personality Questionnaire (IPIP 50 Item)" section in this chapter. Goldberg (1992) provides the reliability measures such as average correlations and alphas for validity purposes. The reliability measures of the SFPQ obtained in this research are going to be compared to Goldberg's (1992) original results.

3.8.4.1 Test and Retest

Respondents might misunderstand or provide a vague answer when taking the SFPQ and the TPQ. Test-retest reliability, also known as the coefficient of stability, is used to avoid any issues with vague answers or misunderstandings. Test-retest assist in investigating if there are any changes in team member's responses from the first test to the second test for both the SFPQ and TPQ questionnaires. In other words, test-retest reliability yields a scoring error of the SFPQ and TPQ when the team members take the survey on two different occasions. The scores for both occasions are later compared utilizing correlation and alpha estimates. Test-retest reliability helps researchers examine the stability of the scoring items over a period of time. It will also help researchers understand if changes in the score were due to an occasional error in the statement items used, which could indicate an issue with the questionnaire statement items (Johnson & Morgan, 2016; Miller & Lovler, 2016). Examples of occasional errors include, but are not limited to, poor writing of questionnaire instructions, poor definition of the terminology/questionnaire items, the usage of complex terminology, using statement items that are not related to the rest of the items, distributing the questionnaire to the wrong population, participants not clearly understanding the statement item, and poor writing structure of the statement items. Other errors that can also influence participants' score to differ between test administrations, which include the participant's mood, fatigue level, personal problems, problems with coworkers, and the time interval between questionnaire administrations (Miller & Lovler, 2016).

The second administration of the SFPQ and TPQ will be distributed to the project teams near the time of the construction project's completion. The time interval between administrations will be approximately three to six months, depending on project completion. Cronbach's alpha and correlation of the scores are utilized to measure the reliability between the two administrations of the questionnaires (Revelle, 2017). To evaluate the reliability using Cronbach's alpha values for research scales, DeVellis (2012) estimated a range for acceptable alpha values that will be utilized, which are described in Table 3.14. Any results below 0.65 are considered questionable reliability, and any results greater than 0.65 are considered acceptable reliability (Johnson et al., 2016; Revelle, 2017). It is worth mentioning that when reliability estimates are based on teams, the coefficient of stability could be as low as 0.50 (Davis, 1964; Johnson et al., 2016). This will be further reviewed as the collected data analysis is being conducted depending on the level of reliability obtained.

Table 3.14. Acceptable Alpha Values According to DeVellis (2012)

Alpha Value	**Decision**
<0.60	Unacceptable
0.60 to 0.65	Undesirable
0.65 to 0.70	Minimally Acceptable
0.70 to 0.80	Respectable
>0.80	Desirable

RS will be used to calculate the necessary estimates for the test-retest reliability. The Psych package includes the essential commands and procedures to complete the calculations. Figure 3.4 below illustrates the command line example needed to perform test-retest reliability in RS and the definition of the words used in the command line.

```
Command line: > testRetest (t1, t2 = NULL, keys = NULL, id= "id", time = "time", select =
NULL, check.keys = TRUE, warnings =TRUE, lmer =TRUE)
```

- **t1:** A data frame or matrix for the first time of measurement.
- **t2:** A data frame or matrix for the second time of measurement.
- **keys:** Item names (or locations) to analyze, preface by "-" to reverse score.
- **id:** Subject identification codes to match across time.
- **time:** The name of the time variable identifying time 1 or 2 if just one data set is supplied.
- **select:** A subset of items to analyze.
- **check.keys:** If TRUE, it will automatically reverse items based upon their correlation with the first principal component.
- **warnings:** If TRUE, it will warn when items are reverse scored.
- **lmer:** lmer is a fit linear mixed-effect model. If TRUE, it will include the lmer variance decomposition.

Figure 3.4. Command line example needed to perform test-retest reliability in RStudio (Revelle, 2017)

3.8.5 Descriptive Statistics

The Psych package provides descriptive statistics such as mean, standard deviation, median, minimum, maximum, range, skewness, kurtosis, and standard error for continuous and discrete type data (Revelle, 2017). Descriptive statistics help to identify outliers and “bad” data points. The skewness and kurtosis index are used to identify the normality of the data. Hair et al. (2010) and Bryne (2010) argued that data is considered to be normal if skewness is between -2 to +2 and kurtosis is between -7 to +7. Outliers will be assessed by visual inspection of box plots as well as the calculation of standardized scores. Standardized score is taking the raw score and converting it into z-score to further evaluate normality. Raw score values of the conditions outside -3 to +3 will be deemed possible outliers (Field, 2018).

3.8.6 Qualitative Comparative Analysis (QCA)

This research aims to demonstrate that the main independent variables, personality traits and team criteria, potentially influence team performance in construction projects. To demonstrate that the independent variables, or conditions in QCA, could influence team performance, the QCA is implemented in this research to explore the relations between the selected conditions. The QCA is a cross-case analysis that uses conditions or their combination to understand which variables influence team performance in this study. QCA uses the analysis of necessity and sufficiency of the conditions that are likely to produce an outcome. "Necessary" means that one condition is essential to produce an outcome, and "sufficiency" means that a combination of conditions are needed to produce an outcome (Befani, 2020; Navarro, Llinares, & Garzon, 2016; Ragin, 2009).

QCA is a means of analyzing the causal contribution to an outcome of interest from various conditions (Thomann, 2020). QCA begins by recording the different combinations of conditions associated with an observed result in each case (Thomann, 2020). These are then subjected to a minimization method that determines the simplest set of conditions that can, as well as their absence, account for all the results observed (Thomann, 2020). In addition, QCA can demonstrate how the conditions can be combined to create a scenario in which positive or negative team performance can be observed (Blatter & Haverland, 2012). The main idea here is to find a link or links between personality traits, team criteria, and team performance, by examining the combination of different conditions and observing how the main variables fit together to create team performance as an outcome. Since the sample size (N) in this research will be small compared to other survey-questionnaire studies, the cross-interpretation of cases and the comparative analysis will help determine how personality traits and team criteria influence team performance in construction projects. Even though the findings will be relatable to the case studies, the objective is to develop the concept that personality traits and team criteria influence team performance, which is different than theory testing (Fiss, 2012; Ragin, 2009).

The conditions determined with the QCA process utilize set theory (a branch of mathematics that studies sets) to model the causal relationship between the main variables and team performance stated in logical statements of necessity and sufficiency (Devers et al., 2013; Fiss, 2012). Set theory in QCA utilizes Boolean operators such as "and," "our," and "not" to assigned logical conditions for the variables that could produce an outcome. Thus, the primary goal when utilizing QCA is to assign cases to sets and specifying the links between the main variables and team performance through a Venn diagram (superset and subset relationships) (Devers et al., 2013). To illustrate how personality traits and team criteria could influence team performance, the Venn diagram shown in Figure 3.5 represents the set theory and relationships for this research.

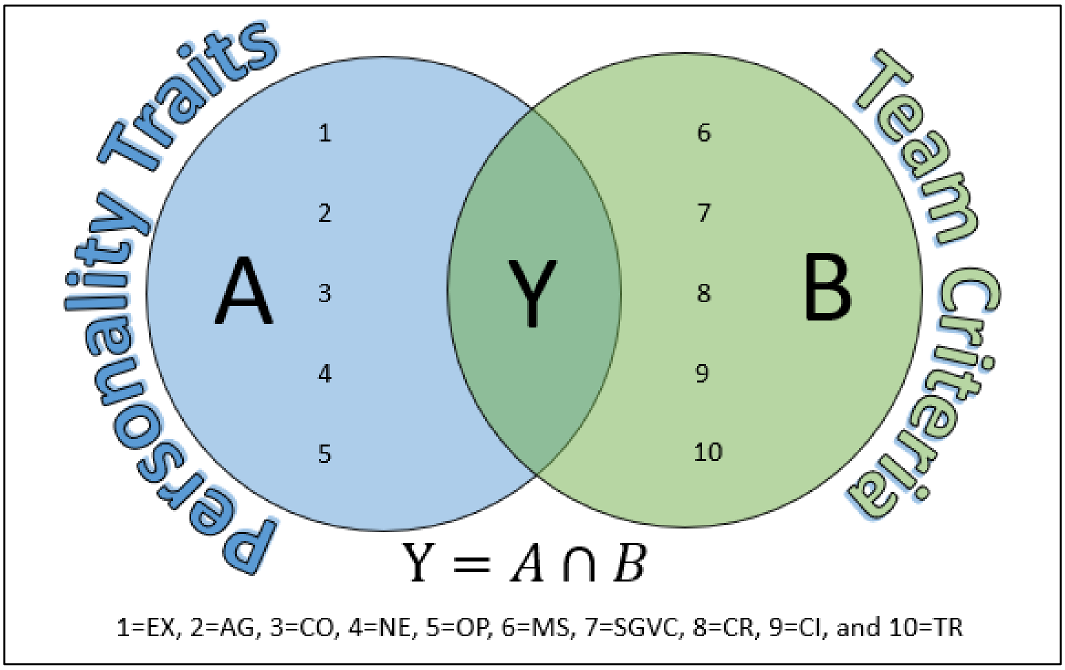

Figure 3.5. Venn Diagram Illustrating the Relationships Between Personality and Team Criteria

Two types of main variables will be utilized in this study, which are personality traits, represented by A, and team criteria, represented by B; performance is represented by Y. High scores and diversity on CO, EX, and AG will produce positive team performance. A low score on NE will produce positive team performance. A neutral score on OP will produce positive team performance. Finally, high scores on team criteria will produce positive team performance. The opposites of these statements produce negative team performance. The subset and superset illustration of these statements are as follows: personality and team performance are subsets (A and B) from all other subsets that could produce team performance (Y). This means that the construction projects (cases) that exhibit A and B could also exhibit Y. In other words, a team that has the right combination of personality traits and team criteria (the conditions) at a certain score should be a good predictor of team performance (Blatter & Haverland, 2012; Devers et al., 2013; Ragin, 2009; Schneider & Wagemann, 2012). This result is demonstrated by the inner circle (A, B) of the Venn diagram.

It is critical to mention that team performance cannot be determined from just personality traits or team criteria alone. There could be alternative variables or factors that could also produce the same outcome, which is a concept known as equifinality (Blatter & Haverland, 2012; Devers et al., 2013). The research focus is to investigate if personality traits and team criteria are either sufficient or necessary for team performance; this leads the research to make combinations of A and B conditions to find the optimal relationship that produces positive team performance in construction teams, which is known as conjunctural. (Blatter & Haverland, 2012; Devers et al., 2013; Ragin, 2009). Finally, QCA helps explain the relationships that produce a negative team performance, which is just as important as a positive team performance. The term for determining weak relationships is known as asymmetry or negation (Devers et al., 2013; Ragin, 2009). Asymmetry assists researchers in understanding negative relationships better. For example, team mistrust is not just the opposite of team trust. There could be another explanation or reason why there is team mistrust in a project, and depending on the answers that team members provide during the case study, it is likely that different levels of mistrust combined with other conditions create a mistrust atmosphere (Schneider & Wagemann, 2012).

3.8.6.1 Steps Necessary to Conduct QCA

It is important to represent QCA properly, and this section describes in detail the necessary steps needed to conduct QCA. Figure 3.6 below is a visual representation of the steps to conduct QCA; it also illustrates the steps used to conduct the second analysis procedure to verify QCA findings.

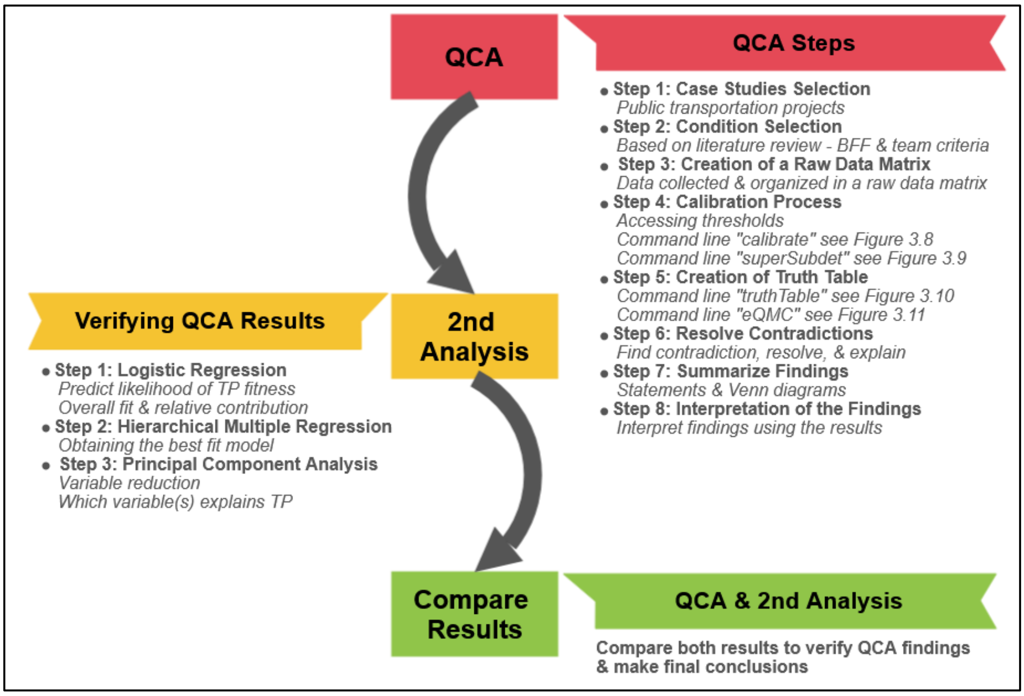

Figure 3.6. Illustration of the steps for conducting QCA and Second Analysis

Step One - Case Studies Selection

The first step in conducting a QCA is to select the projects for the case studies. To conduct the case studies, the construction projects will come from DOT agencies. Originally, the researcher was to include vertical construction projects from ABC and AGC. However, due to COVID-19 and other limitations, the researcher was not able to gain access to construction sites to obtain data from the vertical construction projects. The construction industry uses vertical and horizontal construction terminology to describe the physical orientation of construction projects. Vertical construction refers to projects such as, but not limited, to skyscrapers, multi-family buildings, and commercial buildings. Vertical construction projects are ideal for conserving space and are usually founded by private agencies. Horizontal construction refers to projects that require a lot of land square-footage such as, interstates/highways, bridges, airfields, water/sewer, pipelines, electrical/fiber, and other civil structures. Horizontal projects are usually built by public agencies to aid the economic development and commodity of the area in which they are built. Vertical and horizontal construction have their unique means and methods of construction; they require different types of equipment, different source of funds, different end use, and different skilled trades. However, the construction team managing both vertical and horizontal consists of professionals who have different personalities and are required to work as a team. The personality and team performance measuring tool used in this study should not be affected by project type. Ultimately, the researcher's goal is to determine team performance by evaluating various combinations of personality traits and team criteria within a construction project team regardless of the project type. Therefore, the outcome of this research can still be determined with the horizontal transportation projects.

Step Two - Condition Selection

The second step is to determine the number and types of conditions that are going to be utilized in the study. The number of conditions is not necessarily confined to a formula, but instead, more of a selection based on the investigation. For this study, the conditions were obtained from the literature review for both personality and team criteria. Devers et al. (2013), Blatter and Haverland (2012), Schneider and Wagemann (2012), and Ragin (2009) suggest that the number of conditions should be small such as 3 to 7 conditions. However, Liyanage and Villalba-Romero (2015) conducted QCA with 4 cases and 11 key performance indicators as conditions in a transportation case analysis. Therefore, 5 team criteria conditions and 5 personality traits, totaling ten conditions were designed for this research. The total number of possible combinations for this study is determined by 2^k, where k is the total number of conditions. Theoretically, 1,024 possible combinations are to be analyzed by the RS QCApro package to produce outcomes.

Step Three - Creation of a Raw Data Matrix

The third step is collecting the case studies' data and organizing them in a raw data matrix. The collected raw data must be converted to a fuzzy set; therefore, the data will be collected considering the fuzzy set suitable for QCA. Table 3.15 is an example of the raw data matrix for this research.

Table 3.15. Raw Data Matrix Example

Case ID#	**Personality Trait**					**Team Criteria**					**Outcome**
	EX (1)	**AG (2)**	**CO (3)**	**NE (4)**	**OP (5)**	**MS (6)**	**SGVC (7)**	**CR (8)**	**CI (9)**	**TR (10)**	**Team Performance**
1	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	Score
2	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	1-5	.
.	.	.	.	.	.	.	.	.	.	.	.
n	n	n	n	n	n	n	n	n	n	n	n

Step Four - Calibration Process and Analysis of Necessity

The fourth step consists of calibrating the raw matrix data into the fuzzy set. The calibration process serves to convert the raw data into membership functions necessary to conduct the QCA. However, crisp data can be used to conduct QCA, but it does not have the flexibility to handle scores that are almost in or out of the inclusion threshold. The raw scores' calibration will be conducted using the "*calibrate*" command found in the QCApro package (Thiem, Baumgartner, Dusa, & Spoehel, 2018), which is shown in Figure 3.7.

Command line: > calibrate (x, type = "fuzzy", thresholds = c(Full Incl., Crossover Point, Full Excl.), logistic = TRUE, idm = 0.95, ecdf = TRUE)

- **x:** A casual numerical condition (team member's scores).
- **type:** Calibration type, either "crisp" or "fuzzy".
- **thresholds:** Calibration thresholds 1 = full inclusion, 0.50 = crossover point, & 0.05 = full exclusion.
- **logistic:** If TRUE, it will calibrate using the logistic function.
- **idm:** The set inclusion degree of membership for the logistic function.
- **ecdf:** If TRUE, it will calibrate to fuzzy sets using the raw data's empirical cumulative distribution function.

Figure 3.7. Raw scores' calibration procedure (Thiem et al., 2018)

The personality trait scores will be derived from the Psych package using RS (Revelle, 2017). The Psych package uses the "*score items*" command to score the personality traits, which reports the coefficient alpha (α) value and the average correlation needed for internal validity. The case studies' average correlation will be compared with the meta-analysis to determine how much the case studies results differ from the literature. Calibration threshold for the personality traits were determined by their relative measurement among all the cases studies by using the sample mean and standard deviation to report the score as percentiles. See Table 3.16. In addition, the 50-item questionnaire from Goldberg, uses emotional stability instead of NE, which is the opposite. In this research, we had discussed NE and it negative impact on team performance. Prior to conducting QCA, the emotional stability scores will be reversed by simply subtracting the maximum score, which is five. This will give the opposite score which is NE.

Table 3.16. Personality Trait Fuzzy Set Membership Calibration Threshold

EX	**AG**	**CO**	**NE**	**OP**
0.162	**0.172**	**0.208**	**0.020**	**0.150**
Exclusion 0.05 (25^{th})	Exclusion 0.05 (25^{th})	Exclusion 0.05 (25^{th})	Exclusion 1 (75^{th})	Exclusion 0.05 (25^{th})
Crossover Point 0.50 (50^{th})	Crossover Point 0.50 (50^{th})	Crossover Point 0.50 (50^{th})	Crossover Point 0.50) (50^{th})	Crossover Point 0.50 (50^{th})
Full Inclusion 1(75^{th})	Full Inclusion 1 (75^{th})	Full Inclusion 1 (75^{th})	Full Inclusion 0.05 (25^{th})	Full Inclusion 1 (75^{th})

Team performance is measured utilizing the TPQ. There are nine conditions in total to measure team performance, but only the following conditions will be used in the QCA analysis procedure: 1) "Member Satisfaction" with four items, 2) "Shared Values/Goals/Culture" with four items, 3) "Commitment and Responsibility" with four items, 4) "Communication and Information Sharing" with four items, and 5) "Trust and Respect" with four items. More conditions were used in the TPQ to assess to what degree team members are interacting during the construction of a project. However, to avoid limited diversity according to Devers et al. (2013), it was concluded to only use the five conditions. Limited diversity refers to selecting too many conditions to explain low sample size. The total number of possible combinations will be exponentially high as the number of conditions increases. Since the sample size of this research is expected to be low, the top five conditions of the TPQ will be used along with the five conditions from the SFPQ. The reliability of these measures will be assessed by calculating Cronbach's alpha. A generally accepted rule is that α of 0.60 to 0.70 indicates an acceptable level of reliability, and 0.80 or greater a very good level. Nunnally (1978) recommends a minimum level of 0.70. However, Cronbach's alpha values are dependent on the number of items on the scale. When there are a small number of items on the scale (fewer than 10), Cronbach alpha values can be quite small. In this situation, it is better to calculate and report the mean inter-item correlation for the items, because Cronbach's alpha is very dependent on sample size. Utilizing inter-item correlations will measure whether or not the items "belong together." Optimal mean inter-item correlation values range from 0.20 to 0.40, as recommended by Briggs and Cheek (1986). See Table 3.17 for an example of the score table.

Table 3.17. Team Performance Questionnaire Measurement Example

Common Attribute/Conditions	**Likert Scale Score**	**Total Respondents**	**Team Performance Score**
Member Satisfaction (MS)	1 – 5	-	Score
Shared Values/Goals/Culture (SVGC)	1 – 5	-	Score
Commitment & Responsibility (CR)	1 – 5	-	Score
Communication & Information Sharing (CI)	1 – 5	-	Score
Trust and Respect (TR)	1 – 5	-	Score

Table 3.17 describes the scoring of the question that relates to team criteria. The results for each item will be scored using the "*score item*" command in the Psych package. After scoring each team member, the individual scores will be transferred to MS Excel spreadsheets to score each team member based on their relative position among all cases studies using percentile rank scores. Finally, the team score will be used to perform the fuzzy calibration needed for the QCA analysis. The team performance calibration procedure will be determined using the case study's mean and standard deviation. Using percentile rank that calibrates the raw scores for team performance is adequate for this research since inferences will be made to a localized sample. The mean will sit at the 50th percentile, which will be the crossover point,

the 25th percentile will serve as the full exclusion threshold, and the 75th percentile will serve as the full inclusion threshold. The calibration thresholds are detailed in Table 3.18 for each team criteria condition, while Table 3.19 shows a fuzzy set matrix example after calibration.

Table 3.18. Fuzzy Set Membership Calibration Thresholds for the Conditions & Team Performance Score

MS	**SVGC**	**CR**	**CI**	**TR**	**Team Performance**
F.Excl. 0.05 = (0 – 24th)	F.Excl. 0.05 = (0 – 24th)	F.Excl. 0.05 = (0 – 24th)	F.Excl. 0.05 = (0 – 24th)	F.Excl. 0.05 = (0 – 24th)	F.Excl. 0.05 = (0 – 24th)
*C.O.P.*0.50 = (0.25th – 0.74th)	*C.O.P.*0.50 = (0.25th – 0.74th)	*C.O.P.*0.50 = (0.25th – 0.74th)	*C.O.P.*0.50 = (0.25th – 0.74th)	*C.O.P.*0.50 = (0.25th – 0.74th)	*C.O.P.*0.50 = (0.25th – 0.74th)
F.Incl. 1 = (0.75th – 1)	F.Incl. 1 = (0.75th – 1)	F.Incl. 1 = (0.75th – 1)	F.Incl. 1 = (0.75th – 1)	F.Incl. 1 = (0.75th – 1)	F.Incl. 1 = (0.75th – 1)

Note: Full Exclusion (F.Excl.), Crossover Point (C.O.P.), Full Inclusion (F.Incl.)

Table 3.19. Fuzzy Set Matrix Example after Calibration

Case ID#	**Personality Trait**					**Team Criteria**					**Outcome**
	EX (1)	**AG (2)**	**CO (3)**	**NE (4)**	**OP (5)**	**MS (6)**	**SGVC (7)**	**CR (8)**	**CI (9)**	**TR (10)**	**Team Performance**
1	FV	FV	FV	FV	FV	FV	FV	FV	FV	FV	FV
2	FV	FV	FV	FV	FV	FV	FV	FV	FV	FV	FV
.	.	.	.	.	.	.	.	.	.	.	.
n	n	n	n	n	n	n	n	n	n	n	n

Note: FV = Fuzzy Value

At this point, analysis of necessity can be performed. The analysis of necessity can be obtained by using the "*superSubset*" command found in the QCApro package. The command will produce conditions or a combination of conditions that meet the inclusion and the coverage cutoffs, which help eliminate predefining the combinations manually and missing a worthwhile result (Thiem et al., 2018). The command line for analyzing necessity is detailed in Figure 3.8. To evaluate if a condition or combination of conditions is necessary to produce team performance, the inclusion threshold measure needs to exceed 0.90 (Navarro, Llinares, & Garzon, 2016).

Command line: > superSubset (data, outcome = "Outcome Variable", neg.out = FALSE, xo.facs = c("EX", "AG", "CO", "NE", "OP", "TMS", "SVGC", "CRP","CIS", "TRP"), relation = "nec", incl.cut = 0, cov.cut = 0)

- **data:** A calibrated dataset of bivalent or multivalent crisp-set factors or bivalent fuzzy-set variables.
- **outcome:** The outcome variable (Team Performance).
- **neg.out:** Logical, use negation of outcome.
- **exo.facs:** A character vector with the name of the exogenous factors (Personality Trait & Team Criteria conditions).
- Relation: The relation to the outcome, either “nec”, “suf”, “necsuf”, or “sufnec”.
- **incl.cut:** The minimal inclusion score of the relation.
- **cov.cut:** The minimal coverage score of the relation.

Figure 3.8. Analysis for necessity (Thiem et al., 2018)

The consistency or inclusion function defines a value that indicates the extent to which set X is included in another set Y. In the analysis of necessity, inclusion refers to the proportion (presence) of a condition (or combination of conditions) observed in cases with low or high team performance. A perfect necessity score is 1, which means the condition (or combination of conditions) is observed 100% of the time in the outcome team performance. The low value is 0, meaning the condition (or combination of conditions) is not observed in the outcome team performance. To ensure that only conditions or combinations necessary for high team performance were selected, a high inclusion cutoff of 0.90 was chosen. Similarly, the relevance of necessity refers to the extent to which a condition or combination of conditions is relevant to the outcome of interest. Value of relevance of necessity range between 0 and 1, with 0 indicating irrelevance/trivialness and 1 indicating high relevance. Combinations of conditions with a consistency score of 1 signify that the conditions’ arrangement is present in all the cases. A value of 0.50 was selected in the current study as the relevance of necessity cutoff, implying that each condition or configuration was at least 50% relevant (necessary or almost necessary). Reviewing coverage is also important in determining if a condition is necessary for team performance. The coverage cutoff of 0.5 was selected only to include combinations that cover 50% of the cases. These arguments were included in Step Five.

Step Five - Creation of a Truth Table

The fifth step in the QCA is to combine the conditions, using a fuzzy set truth table to perform the sufficiency analysis. The truth table illustrates the possible combinations between personality traits and team criteria with team performance as the outcome of interest. The main goal of the truth table is to determine which combinations between personality traits and team criteria are sufficient to produce a positive (high performance) or negative (low performance) outcome (Devers et al., 2013; Ragin, 2009). The rows in the truth table represent the possible combinations determined by 2^k as explained earlier, where k is the number of possible combinations. QCApro will generate the truth table during the analysis procedure, which reports sorted combinations, the cumulative percentage, consistency, and coverage scores of the selected cases (Ragin, 2009). The command to produce the truth table is "*truthTable*" in the QCApro package, which can handle both crisp and fuzzy data sets. The data must be in a particular form as illustrated in Table 3.19 and calibrated before creating the truth table. The truth table will produce all possible combinations that are sufficient to produce an outcome (Thiem et al., 2018). However, the inclusion cutoff can be used to only see the combinations of interest. The command line is depicted in Figure 3.9.

```
Command line: > truthTable (data, outcome = "Outcome Variable", incl.cut = 0.80,
show.cases = TRUE, sort.by = c("incl", "n"))
```

- **data:** A data frame containing calibrated causal conditions and an outcome.
- **outcome:** The name or abbreviation of the variable outcome in the data frame.
- **incl.cut:** The inclusion cutoff
- **show.cases:** If TRUE, it will calibrate using the logistic function.
- **sortby:** Sort the truth table according to various columns.

Figure 3.9. Command line for truth table creation (Thiem et al., 2018)

The QCApro package uses Boolean algebra to determine "set membership scores," which helps to find the degree to which each case belongs to personality and team criteria with a combination to predict the outcome. Devers et al. (2013) and Ragin (2009) recommend using asterisk “*” to represent logical “AND”, a plus “+” to represent logical “OR”, and tilde sign “~” will be used to represent not present. A rule is a Boolean algebra representing the combinations to observe team performance. For example, the rule “EX*AG*CO~NE~OP + MS*SGVC*CR*CI*IR → Y”, where *Y* represents team performance; EX, AG, and CO represent conditions to be included; NE and OP represent conditions not included; + represents logical; or, finally, all team criteria conditions are included. QCApro will use this rule to represent combinations that engage in predicting team performance. The rule also states that in cases where more than two conditions are used, the fuzzy membership value representing the combination will be the lower value. It explains to what degree the selected case study teams have or do not have a given combination. To determine the degree to which a team is utilizing a certain combination, the complement values must be utilized in the analysis. When combining conditions utilizing fuzzy membership, the lower fuzzy membership value is used in QCA. For example, if EX and AG are combined with fuzzy values of 0.15 and 0.12, the value used for QCA will be the lowest fuzzy member of the two, which is 0.12 (Devers et al., 2013; Ragin, 2009).

The creation of the truth table will give all possible combinations of sufficient conditions to produce an outcome. The inclusion cutoff value reduces the number of combinations, but it could still create a large table. To find the complex and parsimonious solution of the dataset, QCApro offers a Quine-McCluskey algorithm command to minimize the truth table further, with respect to the outcome (Thiem et al., 2018). The command to conduct the minimization of the truth table is “*eQMC*”, found in the QCApro package and is depicted in Figure 3.10.

Command line: > eQMC (data, outcome = c("Outcome Variable"), neg.out = TRUE, relation = "suf", n.cut = 1, incl.cut1 = 0.80, incl.cut0 = 0, minimize = c("1"), row.dom = TRUE, min.dis = TRUE, details = TRUE, show.cases = TRUE, use.tilde = TRUE, use.letters = TRUE)

- **data:** A truth table object or a set of configurational data (of class 'matrix' or 'data.frame').
- **outcome:** A character vector of outcomes.
- neg.out: Logical, use negation of outcome (ignored if data is a truth table object).
- relation: The required relation of a model antecedent to the outcome; either "suf" (only sufficiency required) or "sufnec" (both sufficiency and necessity required).
- n.cut: The minimum number of cases with set membership score above 0.5 for an output function value of "0", "1" or "C"; an integer between 1 and the maximum number of cases for all non-remainder midterms. Midterm is when a factor appears exactly once in one of its levels.
- incl.cut1: The minimum sufficiency inclusion score for an output function value of "1".
- **incl.cut0:** The maximum sufficiency inclusion score for an output function value of "0".
- minimize: A vector of output function values for which a solution is sought.
- row.dom: Logical, impose row dominance as a constraint on the solution to eliminate dominated inessential prime implicants. For causal data analysis, this argument must be set to FALSE.
- min.dis: Logical, impose minimal disjunctively as a constraint on the solution to eliminate models with more prime implicants than the model(s) with the fewest prime implicants. For causal data analysis, this argument must be set to FALSE.
- Details: Logical, present solution details (inclusion, raw coverage and unique coverage scores).
- show.cases: Logical, also print case names as part of a solution's details; details must be set to TRUE (do not use this option with many cases and/or long case names).
- use.tilde: Logical, use tilde operator ("~") for negation with bivalent (crisp-set and fuzzy-set) factors.

Figure 3.10. Command to conduct the minimization of the truth table (Thiem et al., 2018)

The analysis of sufficiency is conducted when the truth table is created, and minimization of the truth table is completed. The relation argument is set to "*suf*" to obtain the measurement needed to evaluate sufficiency (the details on the command line for sufficiency are illustrated in the minimization of the truth table Figure 3.10).

To assess the strength of the findings, the researcher analyzes the parameter of fit called consistency of the relationships that produces team performance. Consistency helps explain what level the collected data are in line with the findings that actually explain team performance statements (Devers et al., 2013; Verhoeven, 2016). When evaluating sufficiency, QCApro with the "pof" function analyzes consistency by evaluating the conditions and/or combined conditions utilizing an inclusion cutoff value of 0.90. (Ragin, 2009; Schneider & Wagemann, 2012) A consistency or influence value cutoff of 0.90 or greater is a good indicator of the conditions' sufficiency or combined conditions that produce team performance. The QCApro package provides the scripts for the software to produce consistency values as part of the analysis.

Step Six - Resolve Contradictions

The sixth step is to resolve any contradictions. Contradictions for QCA means that a combination of one team's conditions from the selected cases produces positive performance. However, that same combination produces a negative outcome in another case. It is suggested to use the following resolutions when contradictions are present in the truth table:

- Evaluate if the selected case really represents the outcome
- Eliminate combinations that are borderline (slightly below or above 0.5)
- Utilize consistency and frequency criteria (Blatter & Haverland, 2012; Devers et al., 2013; Ragin, 2009).

Step Seven - Summarize Findings

The seventh step is to summarize the findings using statements and Venn diagrams from the truth table. For this research, the Venn diagram will illustrate which conditions produce high or low team performance, similar to what is illustrated in Figure 3.5. The two kinds of relationships that can be analyzed between conditions are necessity and sufficiency. Necessity means that a personality trait or team criteria condition, or the combinations of these, is necessary to produce team performance. Sufficiency means that a condition or combined conditions are sufficient to produce team performance (Blatter et al., 2012; Devers et al., 2013; Ragin, 2009).

On the other hand, necessity means the conditions to produce team performance always need to be present when team performance occurs. Examples of possible statements that could be used in this study to summarize the findings are:

- High team performance scores are observed when (name of the condition(s)) are present
- Low team performance scores are observed when (name of the condition(s)) are present

- High team performance scores are observed when combining personality and team criteria conditions
- Low team performance scores are observed when combining personality and team criteria conditions

Step Eight - Interpretation of the Findings

The eighth and final step is to interpret the research findings in a narrative format, utilizing the statements mentioned previously. There is a possibility that several solutions or combinations that produce team performance could be found in the research. Furthermore, the conditions and/or combination of conditions that produce high and low team performance will be explained and validated with the project site's observations. The findings' presentation will include the raw data matrix, truth table, and parameters of fit (consistency).

3.8.7 Supplemental Analysis

A secondary supplemental analysis will be conducted in order to verify the QCA results. First, logistic regression will be utilized to predict the likelihood of team performance (high or low) based on several independent variables, including personality traits and team criteria. Personality variables are the following 1) extraversion (EX), 2) agreeableness (AG), 3) conscientiousness (CO), 4) neuroticism (NE), and 5) open to experience (OP). The team criteria variables are the followings 1) team composition (TCP), 2) team access to information (TIS), 3) team productive output (TPO), 4) team survivability (TSV), 5) team member satisfaction (TMS), 6) shared values/goals/culture (SVGC), 7) commitment & responsibility (CRP), 8) communication & information sharing (CIS), 9) and trust and respect (TRP). Interaction terms will be added to see which conditions or combinations have a higher log-worth for team performance. Log-worth is a transformed p-value defined as $-log_{10}(pvalue)$ that measures the effects of the model. Conditions or combinations with log-worth greater than 1 are considered to have a significant impact on the model. Binary logistic regression analysis is used to predict a dichotomous dependent variable, team performance in this case, based on the independent variables (Cohen et al., 2003; Mertler & Vannatta, 2013). Additionally, binary logistic regression analysis also determines the overall fit and the relative contribution of each predictor to the total variance explained (Cohen et al., 2003; Mertler & Vannatta, 2013). In binary logistic regression, covariates may be added to the model to control their effects.

Second, hierarchical multiple regression will be conducted by utilizing the original non-dichotomized scores of the independent and dependent variables. The dependent variable (team performance) and the independent variables (personality traits, team criteria, and demographic variables) will be entered into a regression model. The model will consist of interaction terms of various combinations to obtain the best fit model that maximizes the predictability of team performance (Cohen et al., 2003).

Third, principal component analysis (PCA) will be constructed to analyze how many components can explain most of the data (Laerd Statistics, 2021 (Cohen et al., 2003)). PCA is a variable-reduction technique that shares many similarities to exploratory factor analysis. It aims to reduce a larger set of variables into a smaller set of 'artificial' variables (called principal components) that account for most of the variance in the original variables (Laerd Statistics, 2021; Cohen et al., 2003). Eigen values greater than 1 criterion will be utilized in the determination of which items should be retained (Laerd Statistics, 2021; Cohen et al., 2003). Factor analysis will be utilized to see how many factors are most significant. Estimates of means, loading, variances, and covariances for the latent constructs will also be reported.

3.8.8 Assessing Validity and Reliability

Internal Validity

The following functions will be implemented to ensure internal validation:

- QCA internal validity: identifying the relationships between personality traits and team criteria influencing team performance and how these measures agree in displaying that team performance can increase the internal validity of the research when evaluating the consistency of the conditions and combined conditions that produces team performance (Devers et al., 2013; Ragin, 2009). Consistency or inclusion is a score between 0 and 1, which measures how closely the strength of a condition or combined conditions accounts for producing positive or negative team performance. In other words, it helps to identify if the relationship exists. Consistency scores are illustrated in the truth table, which is automatically calculated by the QCApro software. A consistency score of 1.0 will indicate high consistency of the condition or combined conditions, thus proving to influence team performance. A consistency score of 0.0 will indicate that the condition or combined conditions do not influence team performance, thus not supporting the research statement. According to Ragin (2009), the benchmark for fuzzy set consistency scores should be greater than 0.90.

- Internal validity will be accessed with the following thresholds:
    - Necessity - consistency or inclusion greater than 0.90, relevance to necessity greater than 0.80, and coverage greater than 0.80. Estimates above these thresholds were considered reliable for the internal validity. A higher threshold was used to only observed the most influential conditions than what Raging (2009) suggested.
    - Sufficiency - consistency or inclusion greater than 0.90, coverage greater than 0.80, and unique coverage greater than 0.90. Estimates above these thresholds were considered reliable for the internal validity.

After addressing consistency, the next calculation for internal validity is coverage, as consistency alone is not enough to measure internal validity, especially when combining conditions. Coverage is defined as a score that measures the level of importance or empirical weight between conditions and/or combined conditions explaining the influence on team performance (Devers et al., 2013; Ragin, 2009). Coverage also explains the overlap between conditions and/or combined conditions that produce team performance. There is no threshold for coverage, but coverage calculation is only performed on the conditions that have consistency greater than 0.90; coverage will help the researcher rank the conditions and/or combined conditions that have more influence on team performance. See Table 3.20 for a detailed description of the procedure for internal validity between consistency and coverage.

Table 3.20. Procedure for Evaluating Consistency and Coverage

	Cause (Personality & Team Criteria)	**Outcome (team Performance)**
Procedure	Personality and team criteria are subsets of team performance (sufficiency)	Team performance is a subset of personality and team criteria (necessity)
Step 1	Evaluate consistency automatically obtain from QCApro	Evaluate consistency automatically obtain from QCApro
Step 2	If subsets consistent, evaluate coverage automatically obtain from QCApro	If subsets consistent, evaluate coverage automatically obtain from QCApro

Validity through testing the framework on another case or cases is also known as cross-case analysis, which could produce two results (Blatter & Haverland, 2012). The first result will be that the prediction of team performance in the first study is validated in the case or in the postmortem cases. The second result could be that team performance prediction is not valid and could not be reproduced successfully in other cases. The strength of the validity could provide the researcher with sufficient evidence to conduct more studies on a much larger sample size, which could also increase the external validity.

External Validity

Though external validity of the findings was not conducted, the researcher recommends that in any future research, using the tools in this research, should incorporate external validity in the study. Thus, this research is considered a pilot study used to investigate a small sample size of real construction projects to test and evaluate personality traits influence on team performance. According to Yin (2009), many experts have commented that single case studies offer very poor-quality results when generalizing. However, Yin (2009) also explains that this is not necessarily true with case studies. Case studies rely on “analytic generalization,” which "strives to generalize a particular case study to some broader theory." This statement makes sense to this research since the researcher is trying to demonstrate that personality trait differences (e.g., broader theory) influence construction team performance. After the completion of this pilot study, the researcher intends to continue the research to further validate the findings to a much general population by implementing external validity. It will help to use this method, predicting team performance based on personality and team criteria, in other sectors of the construction industry such as infrastructure, industrial, commercial, and residential.

3.8.9 Accessing Reliability

Internal Consistency

Internal consistency reliability is crucial when conducting personality-type research to demonstrate that each statement item selected for the SFPQ indicates the same construct from the original LFPT. Smith et al. (2000) suggest utilizing the interrater reliability measure, which provides a score of how much homogeneity there is between the statement items selected. The IPIP database provides Cronbach's alpha for all the items in the database. The SFPQ internal consistency reports from RS will be compared to the LFPT to ensure relevancy was retained in the selected statement items. As mentioned before, internal consistency provides a clear understanding of whether the number of items selected is adequate to maintain quality and validity from the LFPT. If Cronbach's alpha for the SFPQ is below 0.70, then there is an issue with the total number of items, and there might be a need to increase the number of statement items (Johnson et al., 2016; Revelle, 2017).

3.9 Case Study Protocol

The case study protocol is part of the reliability process, which ensures the research's quality will be consistent, and the research process can be recreated by other researchers (Yin, 2009). The case study protocol ensures data collection is conducted in a proper way according to the research and private information is protected while also tracking any changes that might occur during the research. The protocol has to be flexible due to the possibility of more relevant information being discovered or due to environmental changes that could impede the research process (Yin, 2009). The case study protocol will include the followings aspects (Yin, 2009):

1. The objective of the research
2. Record change
3. Protection plan assurance for subject's privacy
4. Data collection plan
5. Field procedures
6. Analysis
7. Reporting

The case study protocol should ensure the research process in the case studies is conducted professionally and that all data relevant to the research is collected.

3.10 Ethical Considerations

3.10.1 Human Subject Protection

This research aims to determine if personality traits (e.g., EX, AG, CO, NE, and OP) can be used to predict construction-team performance. Successfully answering the research questions requires evaluating people who are part of a construction team. Therefore, it is essential to protect participants' privacy during the case studies. A protection plan for human privacy will be developed and implemented during the case studies to ensure that the participants' personal information and responses will be protected. The protection plan will be part of the case study protocol and will include the following:

1. Informed consent form.
2. How the protection plan will be implemented.
3. Protection of data during collection, analysis, storage, and destruction.

4. CFR 46, LSU policies, and other federal regulations.

3.11 Chapter 3 Summary

Chapter 3 consists of the detailed methodology for this research. The first section discussed the research design, which included target samples, case study research, and an explanation of the questionnaires used to collect the data. The research design's primary purpose is to determine how the research will be carried out on actual construction projects to collect relevant data. The second section discussed each research question's purpose and examined how the methodology will help answer the research questions. The third section includes the data collection plan that will help the researcher collect the data necessary to determine meaningful results and answer the research questions. The fourth section is the analysis procedure. The analysis process will utilize a flexible holistic approach with multiple case studies and combine qualitative and quantitative data using ethnography, to help the researcher understand how personality traits influence team performance on a construction project. It also explains RS and some of the measuring tools that will be used to conduct the analysis. The fifth section describes how validity and reliability will be achieved throughout the analysis process to ensure the research's quality. The sixth and final section briefly explains the importance of human privacy and the need to protect private information. It also explains the outline that will be used to develop a case study protocol.

CHAPTER 4. DATA ANALYSIS

4.1 Introduction

Researchers in existing literature have identified several issues that may affect team performance in construction projects. One of the key factors that have been reported to affect team performance is team criteria, which refers to the guidance and frameworks that help integrate project teams for enhanced performance. Another key factor, which has not been exhaustively studied in existing literature, is personality differences that exist between teams and among team members. While several studies have been conducted on the impact of personality differences on team performance, the same has not been done within the context of the construction sector. As such, the core aim of this research project was to assess the impact of team criteria and personality differences on team performance. In the previous chapter, the researcher outlined the methods and approaches that would be used to collect and analyze data for achieving the aims of this study. In this chapter, the researcher will present the results of the analysis conducted as well as any discrepancies between what was proposed in the previous chapter and what was done during the actual analysis. The chapter is organized into three main sections. In the first section, the researcher will present the results of the reliability analysis conducted on the TPQ and SFPQ instruments used in the study. In the second section, the researcher will present key summary statistics of the data that was collected, access the normality of the data, and if data is normally distributed, then hierarchical regression and logistic can be conducted. Finally, in the third section, the researcher will present findings on the main analysis procedures the QCA and compare the results with logistic regression and hierarchical regression.

The data collection started on April 20, 2020, with 14 case studies beign approved by the Louisiana Department of Transportation and Development (LaDOTD). When the case studies started, the COVID-19 pandemic was ongoing, and it was the responsibility of the onsite personnel and the PE to ensure all CDC guidelines were followed to reduce the spread of COVID-19. Several of the PE's allowed for the researcher to collect data at their projects with the condition to only collect data remotely through email and phone calls, while others refused to give permission. Table 4.1 below details the projects in which permission was granted by the PE and the reasons why other projects were removed from the analysis. This research pursued to gather data from team members who have decision-making responsibilities in the project. The questionnaires were designed to collect personality levels, team performance levels, and demographic information from team members necessary to answer the research questions of this study.

Table 4.1. LaDOTD Construction Projects

No.	Case/Project	Description	Total Team Members		Access Granted (Yes/No)	Reasons for Removal
			LaDOTD	GC		
1	5M2N7	5 miles of milling, pavement patching, and asphalt overlay.	4	6	Yes	
2	0AQD7	3 miles of milling, pavement patching, and asphalt overlay.	3	4	Yes	
3	Q97Y2	13 miles of clearing and grubbing, drainage structures, milling asphalt concrete, in-place cement treated base course, and asphalt concrete overlay.	3	5	Yes	
4	59HQR	10 miles of full depth patching	5	4	Yes	
5	VE6L8	Clearing and grubbing, drainage structures, milling asphalt concrete, in-place cement treated base course, and asphalt concrete overlay.	-	-	No	Permission was not granted
6	C5H8Z	Clearing and grubbing, grading, drainage structures, milling asphalt concrete, in-place cement treated base course, and asphalt concrete overlay.	-	-	No	Permission was not granted
7	ACQ78	Clearing and grubbing, grading, drainage structures, milling asphalt concrete, patching, in-place cement treated base course, and asphalt concrete overlay.	-	-	No	Permission was not granted
8	6Z2Y5	70 miles of micro-milling, patching, and asphalt overlay	4	4	Yes	Same team members were involved in case 9
9	4DH7W	4 miles of milling, pavement patching, sealing, and asphalt overlay	4	4	Yes	
10	9BW2Q	2 miles of clearing & grubbing, bridge removal, drainage improvements, milling, asphalt overlay, and new bridge.	5	12	Yes	

Table 4.1 Continued.

No.	Case/Project	Description	Total Team Members		Access Granted (Yes/No)	Reasons for Removal
			LaDOTD	GC		
11	TW1RK	2 miles of grading, milling asphalt, and asphalt overlay.	3	4	Yes	
12	2PHX5	3 miles of drainage improvement, milling asphalt, patching, and asphalt overlay.	3	5	Yes	Removed due to lack of participation from team members
13	XK9DJ	1 miles of clearing & grubbing, bridge removal, drainage improvements, milling, asphalt overlay, and new bridge	4	7	Yes	
14	5VMQ3	2 miles of drainage improvement, milling asphalt, patching, and asphalt overlay.	4	9	Yes	Removed due to lack of participation from team members

4.2 Research Questions and Hypotheses

This chapter's objective is to answer the following two questions:

- Q3: What personality traits influence team performance in construction projects?
- Q4: How accurately can personality traits and team criteria influence team performance on construction projects?

The following hypotheses assisted in answering question three (Q3):

- Hypothesis 1 (Necessary Conditions): Personality traits (as a personality measuring tool) act as functional equivalents to team criteria in providing the necessary personality levels required for high team performance in construction projects.
- Hypothesis 2 (Sufficiency): The combined presence of at least three personality traits (EX, CO, and AG) and team criteria is linked to high team performance in construction projects.

Question four of this research (Q4) was answered by assessing and comparing the qualitative data (interviews) with the quantitative data (questionnaires). The collection of interviews from the case studies assisted the researcher to access the accuracy of the model and to establish face validity of the findings.

4.3 Description of the Data

The dataset included in the analysis consisted of 11 variables. Ten of the eleven variables were independent variables (personality traits and team criteria) and one dependent variable (team performance). There were two target variables of performance: team performance and individual performance. Thus, team criteria were measured at two levels: individual level and team level, for the QCA. As such, the two variables of team criteria – labeled as Team-Criteria-I and Team-Criteria-T – were decomposed into five variables, as shown in Table 4.2, for each level construct. Lastly, the variable ersonality was also measured at team and individual levels. Hence, two variables were yielded as Personality-I and Personality-T, denoting personality at the individual and team levels, respectively. Each of the two personality variables was further decomposed to five variables for each level construct (Table 4.2).

Table 4.2. Decomposition of the Conditions for Individual and Team Datasets

Team-Criteria-I	**Team-Criteria-T**	**Personality-I**	**Personality-T**
TMS-I	TMS-T	EX-I	EX-T
SVGC-I	SVGC-T	AG-I	AG-T
CRP-I	CRP-T	CO-I	CO-T
CIS-I	CIS-T	NE-I	NE-T
TRP-I	TRP-T	OP-I	OP-T

4.4 Cleaning and Organizing Raw Data

From Table 4.1, case studies VE6L8, C5H8Z, and ACQ78 were removed due to a lack of information and participation from the PEs. As the data collection continued, case 5VMQ3 was dismissed from the research because none of the team members completed the questionnaires. Plenty of time and notifications were given prior to dismissing the case from the research analysis. Case 6Z2Y5 was dismissed from the research because the same project team members were already participating in case 59HQR. The case could not be retained because the observed values would positively or negatively affect the mean and standard deviation, which will improperly describe the sampled population. Case 2PHX5 was removed from the research because only one team member completed the questionnaires. After reviewing each case, team member responses were checked for consistency. After the review of the cases, a total of six cases were removed from this research, leaving eight cases to be included in the analysis. From the eight cases, Table 4.3 details the team members that participated or were removed either for not finishing the questionnaire or failing to complete the second round for test-retest validation. There were two subcontractors who completed the questionnaires. However, other team members did not rate the subcontractor in the team performance questionnaire and for this reason could not be included in the analysis.

Table 4.3. Total Participants Included and Removed from the Analysis

Projects/Cases	SFPQ – T1		SFPQ – T2		TPQ – T1		TPQ – T2	
	Part.	Rem.	Part.	Rem.	Part.	Rem.	Part.	Rem.
0AQD7	3	0	3	0	5	1	5	1
4DH7W	7	2	6	1	6	1	6	1
59HQR	6	0	9	3	10	2	13	5
5M2N7	3	0	3	0	3	0	3	0
9BW2Q	7	1	6	0	8	1	8	1
Q97Y2	4	1	3	0	4	0	4	0
TW1RK	3	0	3	0	4	0	4	0
XK9DJ	5	2	4	1	5	1	6	2
Subtotal	38	6	37	5	45	6	49	10
Total	**32**		**32**		**39**		**39**	

Note: Part. = Participated; Rem. = Removed

4.5 Reliability Analysis

A reliability analysis was conducted using the Psych package in Rstudio version 1.3.1093. Particularly, test-retest reliability and internal consistency reliability were conducted for each of the two questionnaire used in the study. Notably, the two main instruments used in the study were the TPQ and the SFPQ tools. First, the researcher began by assessing the internal consistency of the SFPQ instrument using the *#alpha* command in the Psych Package in Rstudio (Green, 2003). Considering data on the personality traits of project team members were collected at two points in time, separated by three months. The variable 'personality traits' had two datasets – dataset A (first distribution) and B (second distribution), collected at points T1 and T2 in time, respectively – start of construction and end of construction or end of data collection process.

The internal consistency score for dataset A, for the variable 'personality traits' was high (α = 0.89), indicating that the SFPQ instrument was reliable from the internal consistency perspective. Similarly, the internal consistency score for the second dataset collected at point T2 in time was acceptable (α = 0.88) (see Table 4.4). A test-retest reliability was also conducted. To effectively conduct the test-retest reliability, the Cronbach's alpha method was used to determine whether the SFPQ yielded consistent results from time T1 to time T2. The test-retest reliability score was also acceptable (α = 0.86), indicating the SFPQ instrument was effective in measuring personality traits of project team members without being affected by time. Now, the internal consistency for each of the personality traits was conducted. Since the internal consistency of both datasets (A and B) are consistent, the personality traits were analyzed as an average of both datasets. Internal consistency and reliability for each personality trait was acceptable (see Table 4.5), and all five were used in the QCA section.

Table 4.4. Internal Consistency Results for the SFPQ (T1, T2, and Average Scores)

Dataset	**Raw Alpha**	**Std. Alpha**	**G6 (smc)**	**Avg. r**	**S/N**	**ASE**	**Mean**	**SD**	**Median r**
T1	0.89	0.90	0.93	0.15	8.90	0.027	3.60	0.35	0.14
T2	0.88	0.89	0.93	0.14	7.90	0.029	3.40	0.33	0.14
Avg.	0.89	0.90	0.94	0.15	8.70	0.027	3.50	0.33	0.14

Note (T1 & T2): The lower alpha upper 95% confidence boundaries are 0.83 and 0.94 respectively
Note (Avg. Scores): The lower alpha upper 95% confidence boundaries are 0.84 and 0.94 respectively

Table 4.5. Internal Consistency Results for Each Personality Trait (Average Scores)

Estimate	**EX**	**AG**	**CO**	**NE**	**OP**
Std. Alpha	0.91	0.88	0.85	0.82	0.81
G6 (smc)	0.91	0.90	0.88	0.86	0.87
Avg. r	0.49	0.42	0.35	0.32	0.30
S/N	9.70	7.10	5.50	4.70	4.20
ASE	0.05	0.06	0.07	0.07	0.08
Mean	3.16	3.72	3.90	3.61	3.60
Median r	0.52	0.44	0.38	0.36	0.29

The internal consistency score for the TPQ survey instrument was also reliable with a Cronbach's alpha of 94% (α = 94) at T1 and 94% (α = 0.94) at T2. Additionally, the TPQ survey instrument had an acceptable test-retest reliability score (α = 97). Table 4.6 shows the internal consistency test results for the TPQ. The results demonstrated that team members did not change their answers regarding team performance between the first and second round.

Further evaluation was conducted to determine if the TPQ conditions measure the same construct by analyzing Cronbach's alpha for each condition. By evaluating Cronbach's alpha for each condition, the researcher can determine if the conditions are correlating well in the questionnaire. The dataset used was the average scores between T1 and T2. The Cronbach's alpha values were calculated using the *scoreItem* command.

The scores for Team Composition (TCP) and Team Information Sharing (TIS) were not acceptable (α = 0.49 and α = 0.50), as shown in Table 4.7. The scores for the remaining conditions, which were Team Productive Output (TPO), Team Survivability (TSV), Team member satisfaction (TMS), shared values, goals, and culture (SVGC), commitment and responsibility (CRP), communication and information sharing (CIS), and trust and respect (TRP), were acceptable (see Table 4.7). Regarding TCP and TIS, the Cronbach's alpha estimates revealed that there is poor relatedness in the questionnaire items for these two conditions. The researcher removed TCP and TIS and retested TPQ for internal consistency. After the removal of TCP and TIS, TPQ was acceptable as an overall measuring tool. The removal of the two conditions still produced an acceptable overall estimate of Cronbach alpha (α = 0.96) as shown in Table 4.8. Based on this information, TCP and TIS may need to be removed from the questionnaire in future case studies. Furthermore, the results demonstrated that TPQ has good internal consistency and that it is accurate to measure team performance. After the removal, the dataset to perform the QCA consisted of seven team criteria conditions that could be used for analysis: TPO, TSV, TMS, SVGC, CRP, CIS, and TRP.

Table 4.6. Internal Consistency Test Results for the TPQ (T1, T2, and Average Scores)

Dataset	**Raw Alpha**	**Std. Alpha**	**Avg. r**	**S/N**	**ASE**	**Mean**	**SD**	**Median r**
T1	0.94	0.95	0.31	17	0.012	4.10	0.42	0.29
T2	0.94	0.95	0.32	18	0.012	4.10	0.41	0.31
Avg.	0.95	0.95	0.33	19	0.011	4.10	0.40	0.31

Table 4.7. Internal Consistency Results for Each Team Criteria Condition

Estimate	TCP	TIS	TPO	TSV	TMS	SVGC	CRP	CIS	TRP
Std. Alpha	0.49	0.50	0.72	0.86	0.89	0.83	0.86	0.93	0.93
Avg. R	0.16	0.20	0.34	0.60	0.67	0.55	0.61	0.77	0.77
S/N	0.98	0.99	2.50	6.00	8.20	4.9	6.10	14.00	14.00
ASE	0.16	0.18	0.12	0.10	0.093	0.11	0.10	0.083	0.08
Mean	3.76	3.97	3.93	4.29	4.32	4.31	4.20	4.27	4.33
Median r	0.14	0.15	0.37	0.60	0.66	0.56	0.64	0.76	0.78

Table 4.8. TPQ Overall Internal Consistency After Removing TCP and TIS

Raw Alpha	Std. Alpha	Avg. r	S/N	ASE	Mean	SD	Median r
0.96	0.96	0.44	23.0	0.009	4.2	0.46	0.47

4.6 Data Distribution

This section describes how the demographic variables and personality traits in the collected data are distributed between LaDOTD and the general contractor (agency/firm) among all eight case studies. The demographic variables are role, education, age, and year of experience in the construction industry. There were a total of eight cases and 32 participants. However, the TPQ showed 39 participants because some participants rated more than one team member in the questionnaire. The average team size for all eight cases was four team members. Following is an explanation of how the demographic variables were distributed between LaDOTD and the general contractors (GC) (see appendix II for more details). Table 4.9 contains the distribution of demographic variables by agency/firm, and Table 4.10 contains distribution of demographic variables between LaDOTD and the GCs.

It was observed that the GC has the most experience in construction with a mean of 16.22 years compared to 7.721 years for LaDOTD. However, when it came to education levels, LaDOTD had a combined 47.82% of their team members with higher education degrees such as bachelor's and master's, compared to the GC with a combined 22.22%. It was observed that 11.11% of the GC team members were in the 18-30 age range, 44.44% in the 31-40 age range, and 44.44% in the 41-50 age range. This means that 88.88% of the GC's team members were mostly between 31-50 years of age. Only one team member in the GC team was in the 18-30 age range. In the LaDOTD, it was observed that 34.78% were in the 18-30 age range, 30.43% in the 31-40 age range, and 34.78% in the 41+ age range. The age rangewas better distributed among the LaDOTD, compared to the GC, that had a deficiency of younger team members. This age difference could also explain why LaDOTD has a much higher percentage in higher education levels than the GCs. The data distribution revealed that eight LaDOTD team members have a bachelor's degree compared to only two from the GC team. These eight LaDOTD team members were aged between 18-30 years, compared to only one from the GC team. The other team member from the GC with a bachelor's degree was between 31-40 years of age. Table 4.9 below details how role, education, age range, and year of experience is distributed as a combined sample between LaDOTD and the GCs.

Table 4.9. Demographic Variables by Firm/Agency

Variables	**LaDOTD**	**GC**
Roles/Team Members	23	9
Project Manager	4.35%	55.56%
Project Engineers	30.43%	-
Contract Administrators	4.35%	-
Inspectors	61.87%	-
Superintendent	-	44.44%
Education		
Bachelor's Degree	34.78%	22.22%
Master's Degree	13.04%	-
Some College	21.74%	22.22%
High School Diploma	30.43	55.56%
Age Range		
18 – 30	34.78%	11.11%
31 – 40	30.43%	44.44%
41 – 50	30.43%	44.44%
51 and over	4.35%	-
Years of Experience		
Mean	8.61	16.22
Max	25.00	30.00
Min	1.00	3.00

Table 4.10. Demographic Variables Combined Distribution Among LaDOTD and General Contractors

Demographic Variables	**Years of Experience**					
	GC			**LaDOTD**		
	N	**Mean**	**%**	**N**	**Mean**	**%**
Education						
Master	-	-	-	3	4.00	6.06
Bachelor	2	6.00	8.22	8	6.25	25.25
Some College	2	19.5	26.71	5	12.8	32.32
High School	5	19.00	65.07	7	10.29	36.36

Table 4.10 Continued.

<table>
<tr><th rowspan="3">Demographic Variables</th><th colspan="12">Years of Experience</th></tr>
<tr><th colspan="6">GC</th><th colspan="6">LaDOTD</th></tr>
<tr><th colspan="2">N</th><th colspan="2">Mean</th><th colspan="2">%</th><th colspan="2">N</th><th colspan="2">Mean</th><th colspan="2">%</th></tr>
<tr><td colspan="13">Age Range</td></tr>
<tr><td>18 – 30</td><td colspan="2">1</td><td colspan="2">-</td><td colspan="2">2.05</td><td colspan="2">8</td><td colspan="2">4.63</td><td colspan="2">18.69</td></tr>
<tr><td>31 – 40</td><td colspan="2">4</td><td colspan="2">-</td><td colspan="2">22.60</td><td colspan="2">7</td><td colspan="2">6.86</td><td colspan="2">24.24</td></tr>
<tr><td>41 – 50</td><td colspan="2">4</td><td colspan="2">-</td><td colspan="2">75.34</td><td colspan="2">7</td><td colspan="2">12.57</td><td colspan="2">44.44</td></tr>
<tr><td>51 – 60</td><td colspan="2">0</td><td colspan="2">-</td><td colspan="2">-</td><td colspan="2">1</td><td colspan="2">25.00</td><td colspan="2">12.63</td></tr>
<tr><td></td><th colspan="4">GC</th><th colspan="8">LaDOTD</th></tr>
<tr><td></td><th colspan="2">PM</th><th colspan="2">Spr. Intend.</th><th colspan="2">PM</th><th colspan="2">PE</th><th colspan="2">Insp.</th><th colspan="2">Cont. Adm.</th></tr>
<tr><td></td><th>N</th><th>%</th><th>N</th><th>%</th><th>N</th><th>%</th><th>N</th><th>%</th><th>N</th><th>%</th><th>N</th><th>%</th></tr>
<tr><td colspan="13">Education</td></tr>
<tr><td>Master’s</td><td>-</td><td>-</td><td>-</td><td>-</td><td>1</td><td>100</td><td>2</td><td>28.57</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Bachelor’s</td><td>2</td><td>40</td><td>-</td><td>-</td><td>-</td><td>-</td><td>5</td><td>71.43</td><td>3</td><td>21.43</td><td>-</td><td>-</td></tr>
<tr><td>Some College</td><td>1</td><td>20</td><td>1</td><td>25</td><td>-</td><td>-</td><td>-</td><td>-</td><td>5</td><td>35.71</td><td>-</td><td>-</td></tr>
<tr><td>High School</td><td>2</td><td>40</td><td>3</td><td>75</td><td>-</td><td>-</td><td>-</td><td>-</td><td>6</td><td>42.86</td><td>1</td><td>100</td></tr>
<tr><td colspan="13">Age Range</td></tr>
<tr><td>18 – 30</td><td>1</td><td>20</td><td>-</td><td>-</td><td>-</td><td>-</td><td>2</td><td>28.57</td><td>6</td><td>42.86</td><td>-</td><td>-</td></tr>
<tr><td>31 – 40</td><td>4</td><td>80</td><td>-</td><td>-</td><td>1</td><td>100</td><td>2</td><td>28.57</td><td>4</td><td>28.57</td><td>-</td><td>-</td></tr>
<tr><td>41 – 50</td><td>-</td><td>-</td><td>4</td><td>100</td><td>-</td><td>-</td><td>2</td><td>28.57</td><td>4</td><td>28.57</td><td>1</td><td>100</td></tr>
<tr><td>51 – 60</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>1</td><td>14.29</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

4.7 Descriptive Statistics

The tables containing the raw scores (individual level) obtained from the perosnality and team perfroamnce questionnaires at T1, T2, and the average scores between administrations are detailed in Appendix II and Appendix IV, respectively. Descriptive statistics of the PSFQ and the TPQ for each of the questionnaire’s items used can be found in Appendix V and Appendix VI, respectively as well. However, the average scores between T1 and T2 were used to calculate percentiles, which were used to conduct the QCA and regression analysis (see Table 4.11 for the personality questionnaire, and Table 4.12 for the team performance questionnaire). Additionally, the SFPQ selected from the IPIP database measured emotional stability, and in this research, neuroticism (NE) was discussed. NE is the opposite of emotional stability. Thus, each team member’s raw score was subtracted from the maximum score (5) to get the NE scores, which were used in all the analysis procedures.

Table 4.11. Personality Descriptive Statistics Individual Level (Average Raw Scores)

Traits	**N**	**Mean**	**SD**	**Median**	**Min**	**Max**	**Range**	**Skew**	**Kurtosis**	**SE**
EX-I	32	3.16	0.77	3.15	1.35	4.60	3.25	-0.12	-0.33	0.14
AG-I	32	3.72	0.55	3.78	2.50	4.70	2.20	-0.52	-0.31	0.10
CO-I	32	3.88	0.50	3.88	3.00	4.90	1.90	0.41	-0.42	0.09
NE-I	32	1.41	0.49	1.40	0.00	2.10	2.10	-0.80	0.61	0.08
OP-I	32	3.60	0.44	3.50	2.70	4.60	1.90	0.33	-0.13	0.08

Table 4.11 Continued.

Team Members	EX-I	AG-I	CO-I	NE-I	OP-I
0AQD7-OW-GC-1	3.00	3.70	3.50	1.10	3.40
0AQD7-GC-OW-2	2.95	3.85	4.05	2.10	3.65
0AQD7-OW-OW-3	2.35	4.40	4.30	1.20	3.70
4DH7W-OW-OW-1	2.25	4.25	4.90	1.90	4.30
4DH7W-OW-OW-2	3.00	3.40	3.95	1.75	3.55
4DH7W-OW-OW-3	3.10	3.50	3.40	1.60	3.20
4DH7W-OW-GC-4	1.35	3.10	3.65	0.00	2.70
4DH7W-GC-OW-5	4.20	4.00	3.00	1.20	3.50
59HQR-OW-OW-1	2.10	4.25	4.70	1.75	4.15
59HQR-OW-OW-3	3.15	4.20	3.85	1.00	4.20
59HQR-OW-OW-5	3.20	3.20	4.10	1.40	3.50
59HQR-GC-OW-6	4.40	4.70	4.70	0.25	4.60
59HQR-OW-GC-7	3.45	2.55	4.00	0.65	3.45
59HQR-OW-GC-8	3.60	4.10	3.70	1.10	3.40
5M2N7-OW-GC-1	3.15	3.20	3.60	1.00	3.50
5M2N7-GC-OW-2	2.90	4.30	4.00	2.00	3.30
5M2N7-OW-GC-3	2.90	3.40	3.90	0.90	3.70
9BW2Q-OW-GC-1	4.20	4.25	3.35	1.40	3.90
9BW2Q-OW-GC-2	2.40	4.10	3.90	2.00	4.10
9BW2Q-OW-GC-3	3.30	4.00	4.40	1.30	3.65
9BW2Q-GC-OW-4	3.45	3.90	3.85	1.85	3.05
9BW2Q-OW-OW-5	3.85	3.40	4.80	2.10	3.30
9BW2Q-OW-GC-7	3.90	3.60	3.95	1.55	3.50
Q97Y2-OW-OW-1	2.40	2.80	3.40	1.50	3.90
Q97Y2-OW-GC-3	3.40	3.10	4.00	1.90	3.25
Q97Y2-GC-OW-4	4.60	4.30	4.60	0.80	4.40
TW1RK-OW-OW-1	2.25	3.55	3.10	1.40	3.50
TW1RK-GC-OW-3	2.60	3.70	3.30	2.00	2.80
TW1RK-GC-OW-4	3.45	2.50	3.70	1.80	3.35
XK9DJ-OW-OW-1	4.20	4.10	3.75	1.40	3.95
XK9DJ-OW-OW-3	2.20	4.00	3.40	1.30	3.30
XK9DJ-GC-OW-4	3.90	3.50	3.35	1.40	3.50

Table 4.12. Team Criteria Descriptive Statistics Individual Level (Average Raw Scores)

Conditions	N	Mean	SD	Median	Min	Max	Range	Skew	Kurtosis	SE
TMS-I	39	4.32	0.590	4.50	3.00	5.00	2.00	-0.54	-0.77	0.09
SVGC-I	39	4.31	0.54	4.50	3.25	5.00	1.75	-0.36	-1.04	0.09
CRP-I	39	4.19	0.58	4.00	3.00	5.00	2.00	-0.09	-0.99	0.09
CIS-I	39	4.27	0.68	4.25	3.00	5.00	2.00	-0.33	-1.29	0.11
TRP-I	39	4.33	0.68	4.63	3.00	5.00	2.00	-0.64	-0.97	0.11

Team Members	TMS-I	SVGC-I	CRP-I	CIS-I	TRP-I
0AQD7-OW-GC-1	3.75	3.50	4.00	3.00	3.75
0AQD7-GC-OW-2	4.63	4.50	4.50	5.00	5.00
0AQD7-OW-OW-3	5.00	4.50	4.13	5.00	5.00
0AQD7-OW-GC-4	4.25	4.13	4.00	3.75	4.25
4DH7W-OW-OW-1	4.50	5.00	4.88	4.50	5.00
4DH7W-OW-OW-2	4.38	4.25	4.63	4.75	4.63
4DH7W-OW-OW-3	3.50	3.50	3.50	3.50	3.50
4DH7W-OW-GC-4	3.63	3.75	3.50	3.50	3.50
4DH7W-GC-OW-5	4.75	4.50	3.50	5.00	4.75
59HQR-OW-OW-1	5.00	4.63	4.88	5.00	5.00
59HQR-OW-GC-2	5.00	4.88	4.88	4.00	5.00
59HQR-OW-OW-3	5.00	5.00	5.00	5.00	5.00
59HQR-OW-GC-4	4.75	5.00	4.88	5.00	5.00
59HQR-OW-OW-5	4.63	4.75	4.88	4.88	4.75
59HQR-GC-OW-6	4.88	4.75	4.00	5.00	4.88
59HQR-OW-GC-7	4.13	3.88	4.00	4.00	3.00
59HQR-OW-GC-8	4.00	4.13	4.00	4.13	4.00
5M2N7-OW-GC-1	4.00	4.00	4.00	3.75	4.00
5M2N7-GC-OW-2	5.00	5.00	5.00	5.00	5.00

Table 4.12 Continued.

Team Members	TMS-I	SVGC-I	CRP-I	CIS-I	TRP-I
5M2N7-OW-GC-3	3.50	4.00	3.75	3.50	4.00
9BW2Q-OW-GC-1	4.25	4.13	4.00	4.00	4.00
9BW2Q-OW-GC-2	5.00	4.88	5.00	5.00	5.00
9BW2Q-OW-GC-3	4.50	4.00	3.50	3.50	3.75
9BW2Q-GC-OW-4	4.00	4.50	4.00	4.13	4.50
9BW2Q-OW-OW-5	5.00	4.75	5.00	5.00	5.00
9BW2Q-OW-GC-6	3.50	3.75	3.88	3.25	3.25
9BW2Q-OW-GC-7	3.00	3.75	3.00	3.00	3.00
Q97Y2-OW-OW-1	4.00	3.25	3.25	4.00	3.00
Q97Y2-OW-GC-2	3.25	3.25	3.25	3.25	3.50
Q97Y2-OW-GC-3	4.75	4.50	4.50	4.50	4.75
Q97Y2-GC-OW-4	4.50	3.50	4.00	4.75	4.75
TW1RK-OW-OW-1	3.25	3.75	4.38	4.50	3.50
TW1RK-OW-GC-2	4.50	4.75	4.75	4.25	4.63
TW1RK-GC-OW-3	4.13	4.75	4.00	3.75	4.50
TW1RK-GC-OW-4	4.75	5.00	4.50	5.00	4.75
XK9DJ-OW-OW-1	4.25	4.75	3.75	4.00	4.25
XK9DJ-OW-GC-2	3.75	4.00	3.75	3.50	3.75
XK9DJ-OW-OW-3	5.00	5.00	5.00	5.00	5.00
XK9DJ-GC-OW-4	5.00	4.25	4.25	5.00	5.00

The team level raw scores using the average scores between T1 and T2 are detailed in Table 4.13 for personality traits and Table 4.14 for team criteria below. The average scores were used to conduct the QCA and regression analysis.

Table 4.13. Personality Descriptive Statistics Team Level (Average Raw Scores)

Conditions	N	Mean	SD	Median	Min	Max	Range	Skew	Kurtosis	SE
EX-T	8	3.07	0.38	3.06	2.64	3.63	0.99	-1.3	0.37	0.13
AG-T	8	3.7	0.3	3.73	3.25	4.09	0.84	-0.95	-0.46	0.1
CO-T	8	3.84	0.3	3.84	3.3	4.2	0.9	-0.01	-0.65	0.11
NE-T	8	1.41	0.21	1.39	1.11	1.76	0.64	0.07	0.51	0.07
OP-T	8	3.61	0.22	3.58	3.29	3.96	0.67	-0.38	0.32	0.08

Team Members	EX-T	AG-T	CO-T	NE-T	OP-T
0AQD7	2.66	4.09	4.04	1.40	3.61
4DH7W	2.78	3.65	3.78	1.29	3.45
59HQR	3.14	3.93	4.20	1.11	3.96
5M2N7	2.98	3.63	3.83	1.30	3.50
9BW2Q	3.56	3.81	4.15	1.76	3.54
Q97Y2	3.20	3.25	3.85	1.43	3.86
TW1RK	2.64	3.33	3.30	1.65	3.29
XK9DJ	3.63	3.93	3.56	1.38	3.68

Table 4.14. Team Criteria Descriptive Statistics Team Level (Average Raw Scores)

Conditions	N	Mean	SD	Median	Min	Max	Range	Skew	Kurtosis	SE
TMS-T	8	4.29	0.21	4.17	4.13	4.67	0.55	1.08	-0.26	0.07
SVGC-T	8	4.28	0.32	4.29	3.63	4.63	1.00	-1.25	2.19	0.11
CRP-T	8	4.17	0.25	4.17	3.75	4.56	0.81	-0.11	0.28	0.09
CIS-T	8	4.25	0.20	4.22	3.98	4.63	0.64	0.66	0.30	0.07
TRP-T	8	4.33	0.21	4.34	4.00	4.58	0.58	-0.51	0.87	0.07

Table 4.14 Continued.

Team Members	TMS-T	SVGC-T	CRP-T	CIS-T	TRP-T
0AQD7	4.41	4.16	4.16	4.19	4.50
4DH7W	4.15	4.20	4.00	4.25	4.28
59HQR	4.67	4.63	4.56	4.63	4.58
5M2N7	4.17	4.33	4.25	4.08	4.33
9BW2Q	4.18	4.25	4.05	3.98	4.07
Q97Y2	4.13	3.63	3.75	4.13	4.00
TW1RK	4.16	4.56	4.41	4.38	4.34
XK9DJ	4.50	4.50	4.19	4.38	4.50

4.8 Assumptions Testing

In the proposed study, the researcher intended to conduct parametric tests (hierarchical regression and logistic regression), hence assumptions testing was necessary. There are three main assumptions associated with parametric statistical tests: normality, multicollinearity, and homogeneity of variances. In the current study, normality, multicollinearity, and homogeneity of variances were tested using the Skewness and Kurtosis test, the Variance Inflation Factor (VIF) test, and the Levene's test of homogeneity of variances, respectively.

4.9 Normality Test

Normality test was conducted on standardized data consisting of a total of 11 variables (years of experience, TMS, SVGC, CRP, CIS, TRP, EX, AG, CO, NE, and OP). While the data consisted of 19 variables, eight categorical variables were excluded from the analysis: team performance, case number, team member, agency/firm, role, education, age range, and team member evaluated. Particularly, the skewness and kurtosis tests for normality were used to ascertain whether each of the 12 variables consisted of normally distributed data. Skewness values falling between -1 and 1 and kurtosis values falling between -2 and 2 indicate that the data is normally distributed. The *Distribution Function* in JMP Pro was used to determine the standardized scores of the ten conditions. It was also used to determine their skewness and kurtosis values for the conditions in the dataset (see Tables 4.11, 4.12, 4.13, and 4.14). The skewness and kurtosis revealed that all the 11 variables included in the normality assessment had skewness values falling between 1 and -1 and kurtosis values falling between 2 and -2 at the individual level. Consequently, the normality assumption on scale data was met. However, at the team level, SVGC-T was verily outside normality (skewness -1.25 and kurtosis 2.19). According to Hair et al. (2010), in multivariate type analysis, a skewness limit between -2 and 2 and kurtosis between -7 and 7 are acceptable. Since the SVGC-T was verily outside the range for skewness and kurtosis, the researcher concluded that team level dataset met normality.

The dataset was furthered reviewed by visually inspecting the Normal Quantile Plot at the individual level. The normal quantile plots for the 11 variables revealed that the variables have a wavy shaped line (see Figures 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, and 4.11). The personality traits were all within the Lilliefors confidence bounds (dotted red lines). However, CRP, CIS, TRP, and years of experience had one or three scores outside the Lilliefors confidence bounds. Since the dataset was considered normal based on skewness and kurtosis, the normal quantile plot indicated that the data is borderline normal. This could be a result of the low data sample in this research.

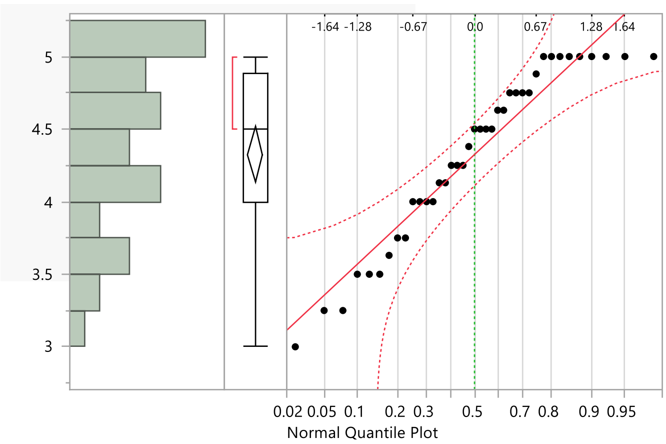

Figure 4.1. Team Member Satisfaction (TMS)

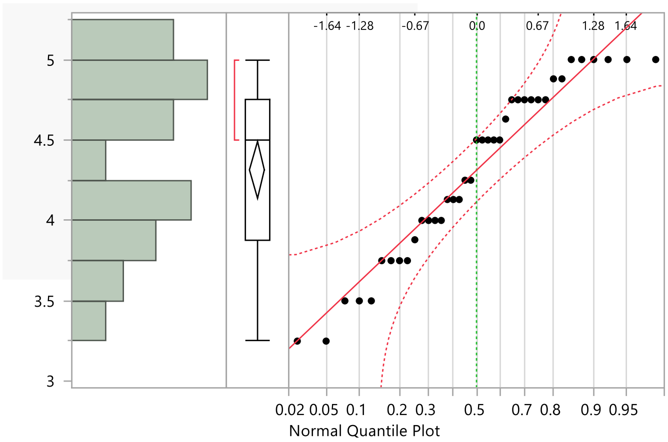

Figure 4.2. Shared/Values/Goals/Culture (SVGC)

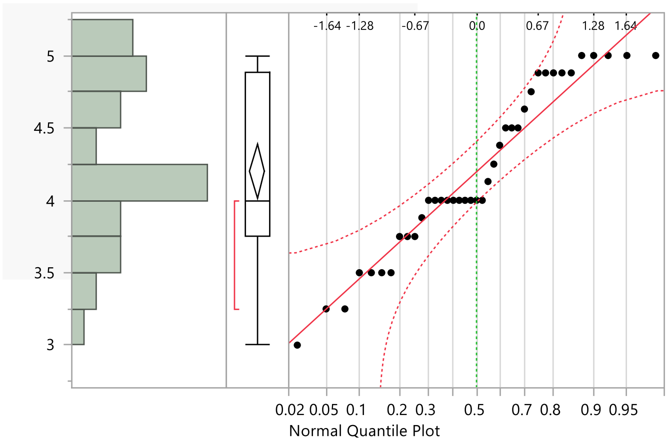

Figure 4.3. Commitement and Responsibility (CRP)

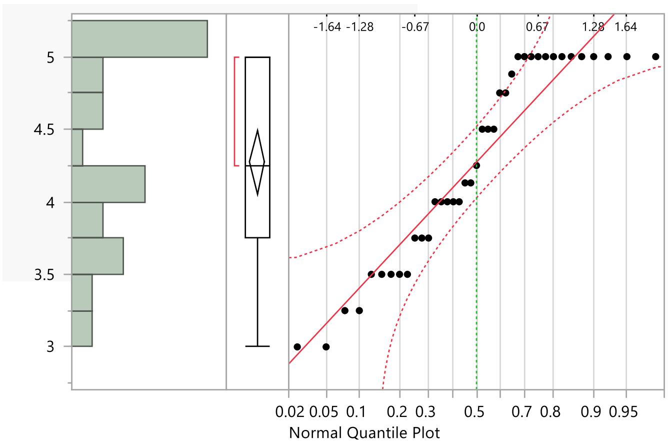

Figure 4.4. Communication and Information Sharing (CIS)

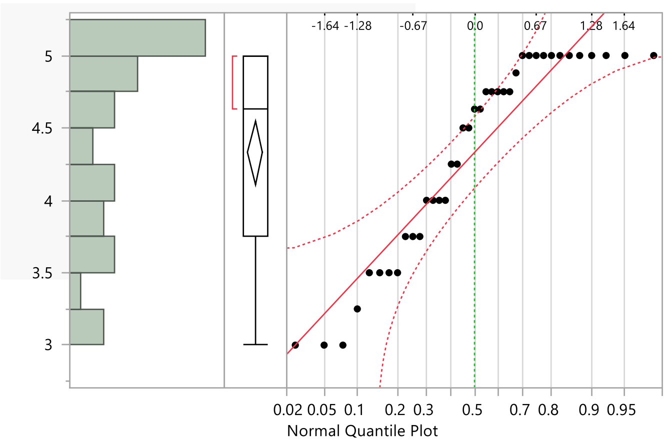

Figure 4.5. Trust and Respect (TRP)

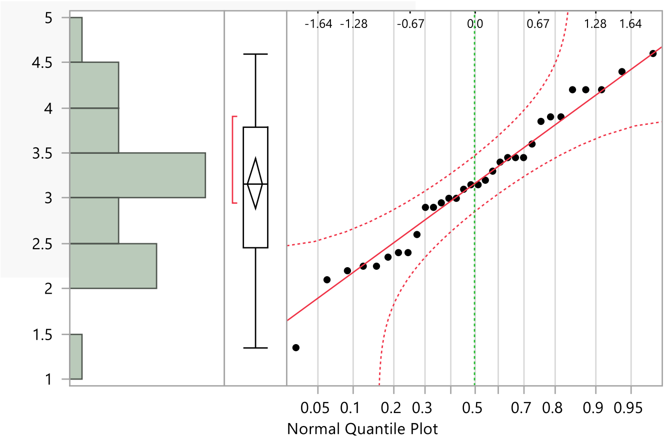

Figure 4.6. Extraversion (EX)

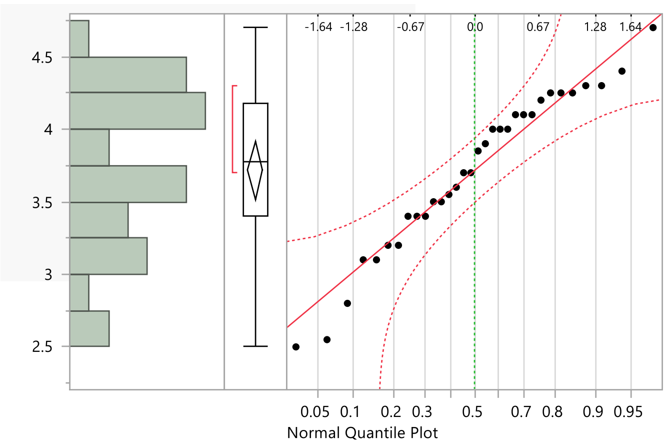

Figure 4.7. Agreeableness (AG)

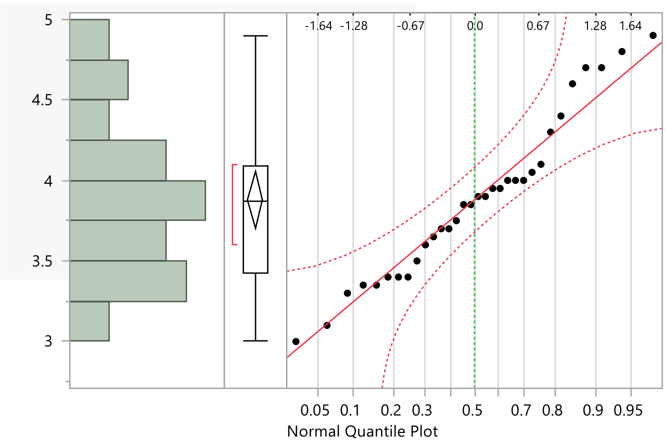

Figure 4.8. Conscientiousness (CO)

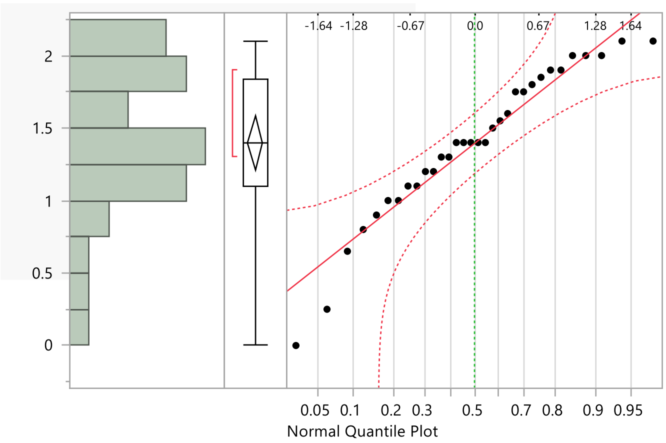

Figure 4.9. Neuroticism (NE)

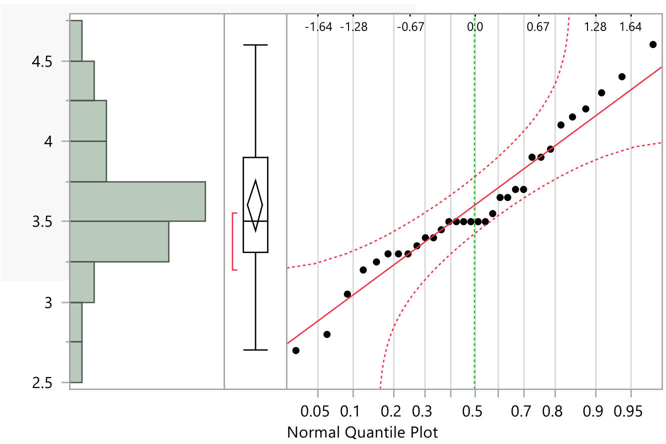

Figure 4.10. Open to Experiance (OP)

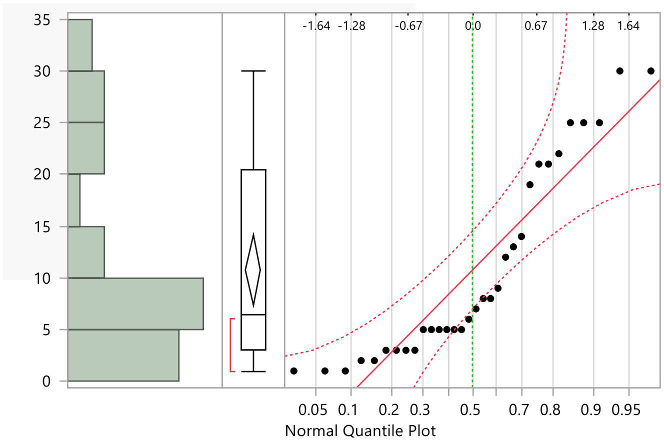

Figure 4.11. Years of Experience

4.10 Multicollinearity Assumption Test

The variance inflation factor or VIF method was used to test the multicollinearity among variables in the dataset. VIF indicates the extent to which variables are correlated with each other in a model. A VIF of greater than 10 indicates presence of multicollinearity. To test for multicollinearity using the VIF method in JMP Pro, a fit model (fit least squares) was used in which Y was assigned as the outcome (individual level team performance scores) and X as the predictor variable (conditions), where the object fit represents the fitted model while VIF is a function for calculating VIF. , To test VIF, the fit least square was conducted on the five personality traits of EX, AG, CO, NE, and OP, and the fiveteam criteria of TMS, SVGC, CRP, CIS, and TRP. None of the variables tested had a presence of multicollinearity (Table 4.15).

Table 4.15. Variance Inflation Factor (VIF) Test Using Fit Least Squares (n = 39)

No.	**Variables**	**VIF**
1	TMS	5.53
2	SVGC	4.01
3	CRP	4.04
4	CIS	4.54
5	TRP	7.41
6	EX	1.29
7	AG	1.93
8	CO	1.44
9	NE	1.28
10	OP	1.69

4.11 Scoring Personality Questionnaire

The raw scores of the personality questionnaire obtained from the *scoreItem* command in RStudio are detailed in appendix VII. This section will present scores based on their relative position among all sample cases. As suggested by Goldberg (2006) in the IPIP database, score interpretation for each personality trait was 1) low in the zero to 31st percentile, 2) average in the 32nd to 69th percentile, and 3) high for the 70th percentile and above. Table 4.16 below contains all team member's personality levels and their average personality at the team level.

Table 4.16. Individuals and Teams Personality Trait Levels (Individuals = 32, Teams = 8)

n	Case	Agency/Firm	Individual					Team				
			EX	**AG**	**CO**	**NE**	**OP**	**EX**	**AG**	**CO**	**NE**	**OP**
1	0AQD7	Owner	Avg	Avg	Low	Low	Low	Low	High	High	Avg	Avg
2	0AQD7	GC	Avg	Avg	High	High	Avg					
3	0AQD7	Owner	Low	High	High	Low	Avg					
4	4DH7W	Owner	Low	High	High	High	High	Low	Avg	Low	Low	Low
5	4DH7W	Owner	Avg	Low	Avg	Avg	Avg					
6	4DH7W	Owner	Avg	Avg	Low	Avg	Low					
7	4DH7W	Owner	Low	Low	Avg	Low	Low					
8	4DH7W	GC	High	Avg	Low	Low	Avg					
9	59HQR	Owner	Low	High	High	Avg	High	Avg	High	High	Low	High
10	59HQR	Owner	Avg	High	Avg	Low	High					
11	59HQR	Owner	Avg	Low	High	Avg	Avg					
12	59HQR	GC	High	High	High	Low	High					
13	59HQR	Owner	Avg	Low	Avg	Low	Avg					
14	59HQR	Owner	High	Avg	Avg	Low	Low					
15	5M2N7	Owner	Avg	Low	Low	Low	Avg	Avg	Low	Avg	Low	Low
16	5M2N7	GC	Avg	High	Avg	High	Low					
17	5M2N7	Owner	Avg	Low	Avg	Low	Avg					
18	9BW2Q	Owner	High	High	Low	Avg	Avg	High	Avg	High	High	Avg
19	9BW2Q	Owner	Low	Avg	Avg	High	High					
20	9BW2Q	Owner	Avg	Avg	High	Avg	Avg					
21	9BW2Q	GC	Avg	Avg	Avg	High	Low					
22	9BW2Q	Owner	High	Low	High	High	Low					
23	9BW2Q	Owner	High	Avg	Avg	Avg	Avg					
24	Q97Y2	Owner	Low	Low	Low	Avg	Avg	High	Low	Avg	High	High
25	Q97Y2	Owner	Avg	Low	Avg	High	Low					
26	Q97Y2	GC	High	High	High	Low	High					
27	TW1RK	Owner	Low	Avg	Low	Avg	Avg	Low	Low	Low	High	Low
28	TW1RK	GC	Avg	Avg	Low	High	Low					
29	TW1RK	GC	Avg	Low	Avg	High	Low					
30	XK9DJ	Owner	High	Avg	Avg	Avg	High	High	High	Low	Avg	High
31	XK9DJ	Owner	Low	Avg	Low	Avg	Low					
32	XK9DJ	GC	High	Avg	Low	Avg	Avg					

Note: Percentile scores are in appendix VIII

Following is an explanation for each team located on the personality traits spectrum, Based on Table 4.16 above,:

1. Case Study 0AQD7:

    a. **Extraversion:** The team's score was low (14.20 percentile). The team reflects signs of being ineffective, reduced team cohesiveness, low levels of communication, and low levels of coordination.

    b. **Agreeableness:** The team's score was high (100 percentile). The team reflects signs of high vitality, concern for team success over personal, trust among team members, better conflict resolution, open communication, flexibility towards changes, team members working well with each other, and less competition among team members.

    c. **Conscientiousness:** The team's score was high (71.50 percentile). The team reflects signs of engagement in goals or planning goals, performing tasks in detail, enthusiasm with team members, high levels of organization, higher job satisfaction, and higher levels of productive behavior.

    d. **Neuroticism:** The team's score was average (57.10 percentile). The team reflects some signs of high NE. High NE indicates some signs of reduced team cohesiveness, disruption of task coordination due to an ill-temper, high levels of disagreement, anti-social team environment, and higher impulsive behavior which hurts communication. Its worth mentioning that according to the literature, it only takes one team member with high NE to disrupt team performance (Kramer, Bhave, & Johnson, 2014).

    e. **Open to Experience:** The team's score was average (57.10 percentile). The team is located more on the high side of the spectrum. High OP indicates some signs of generating noble solutions, not avoiding conflict and approaching conflict with collaboration, high flexibility to changes, higher levels of adaptation, and promoting open discussions.

2. Case Study 4DH7W:

    a. **Extraversion:** The team's score was Low (28.50 percentile). Team reflects signs of being ineffective, reduced team cohesiveness, low levels of communication, and low levels of coordination.

    b. **Agreeableness:** The team's score was average (42.80 percentile). The team is more on the low side of the spectrum. The team reflects some signs of reduced team effort, lack of response to team members, focus only on individual efforts, higher competition among team members, and more arguments.

    c. **Conscientiousness:** The team's score was low (28.50 percentile). The team reflects signs of being ineffective, lack of goals, lack of cooperation and organization, counterproductive behavior, and low job satisfaction.

    d. **Neuroticism:** The team score was low (14.20 percentile). The team reflects signs of team cohesiveness, effective decision making, high conflict management, high levels of cooperation, more open communication, emotional stability during discussions, and a peaceful team environment. Though the score is low in NE for team level, only two members are the low side and two on the average side. One team member in on the high side, which could disrupt team dynamics and cause low team performance.

    e. **Open to Experience:** The team's score was low (14.20 percentile). The team

3. Case Study 59HQR:

    a. **Extraversion:** The team's score was average (57.10 percentile). The team is more on the high side of the spectrum and reflects some signs of team cohesiveness, higher communication, and higher coordination.

b. **Agreeableness:** The team's score was high (85.70 percentile). The team reflects signs of high vitality, concern for team success over personal, trust among team members, better conflict resolution, open communication, flexibility towards changes, team members working well with each other, and less competition among team members.

c. **Conscientiousness:** The team's score was high (100 percentile). Team reflects signs of being engaged in goals or planning goals, performing tasks in detail, enthusiasm with team members, high levels of organization, higher job satisfaction, and higher levels of productive behavior.

d. **Neuroticism:** The team's score was low (0 percentile). The team reflects signs of team cohesiveness, effective decision making, high conflict management, high levels of cooperation, more open communication, emotionally stable during discussions, and a peaceful team environment.

e. **Open to Experience:** The team's score was high (100 percentile). The team reflects signs of generating noble solutions, not avoiding conflict and approaching conflict with collaboration, high flexibility towards changes, higher levels of adaptation, and promoting open discussions.

4. Case Study 5M2N7:

   a. **Extraversion:** The team's score was average (42.80 percentile). The team is more on the low side of the spectrum. Team reflects some signs of being ineffective, reduced team cohesiveness, low levels of communication, and low levels of coordination.

   b. **Agreeableness:** The team's score was low (28.50 percentile). The team reflects signs of reduced team effort, lack of response to team members, focus only on individual efforts, higher competition among team members, and more arguments.

c. **Conscientiousness:** The team's score was average (42.80 percentile). The team is more on the low side of the spectrum. Team reflects some signs of being ineffective, lack of goals, lack of cooperation and organization, counterproductive behavior, and low job satisfaction.
d. **Neuroticism:** The team's score was low (28.50 percentile). The team reflects signs of team cohesiveness, effective decision making, high conflict management, high levels of cooperation, more open communication, emotionally stable during discussions, and a peaceful team environment.
e. **Open to Experience:** The team's score was low (28.50 percentile). The team reflects signs of lack of creative solutions, sticking to stablished methods, struggle to resolve issues, the team feeling threatened by new methods, avoiding open discussion, and not being flexible towards changes which affect adaptation.

5. Case Study 9BW2Q:
    a. **Extraversion:** The team's score was high (85.70 percentile). The team reflects signs of team cohesiveness, higher communication, and higher coordination.
    b. **Agreeableness:** The team's score was average (57.10 percentile). The team is more on the high side of the spectrum. The team reflects some signs of high vitality, concern for team success over personal, trust among team members, better conflict resolution, open communication, flexibility towards changes, team members working well with each other, and less competition among team members.

c. **Conscientiousness:** The team's score was high (85.70 percentile). The team reflects signs of being engaged in goals or planning goals, performing tasks in detail, enthusiasm with team members, high levels of organization, higher job satisfaction, and higher levels of productive behavior.

d. **Neuroticism:** The team's score was high (100 percentile). The team reflects signs of reduced team cohesiveness, disruption of task coordination due to ill-temper, high levels of disagreement, anti-social team environment, and higher impulsive behavior which hurts communication.

e. **Open to Experience:** The team average (42.80 percentile). The team is more on the low side of the spectrum. The team reflects some signs of lack of creative solutions, sticking to stablished methods, struggle to resolve issues, team feeling threatened by new methods, avoiding open discussion, and not flexible towards changes which affect adaptation.

6. Case Study Q97Y2:

   a. **Extraversion:** The team's score was high (71.40 percentile). The team reflects signs of team cohesiveness, higher communication, and higher coordination.

   b. **Agreeableness:** The team's score was low (0 percentile). The team reflects signs of reduced team effort, lack of response to team members, focus only on individual efforts, higher competition among team members, and more arguments.

   c. **Conscientiousness:** The team's score was average (57.10 percentile). The team is more on the high side of the spectrum. Team reflects some signs of being engaged in goals or planning goals, performing tasks in detail, enthusiasm with team members, high levels of organization, higher job satisfaction, and higher levels of productive behavior.

d. **Neuroticism:** The team's score was high (71.40 percentile). The team reflects signs of reduced team cohesiveness, disruption of task coordination due to ill-temper, high levels of disagreement, anti-social team environment, and higher impulsive behavior which hurts communication.

e. **Open to Experience:** The team's score was high (85.70 percentile). The team reflects signs of generating noble solutions, not avoiding conflict and approaching conflict with collaboration, high flexibility towards changes, higher levels of adaptation, and promoting open discussions.

7. Case Study TW1RK:

a. **Extraversion:** The team's score was low (0 percentile). The team reflects signs of being ineffective, reduced team cohesiveness, low levels of communication, and low levels of coordination.

b. **Agreeableness:** The team's score was low (14.20 percentile). The team reflects signs of reduced team effort, lack of response to team members, focus only on individual efforts, higher competition among team members, and more arguments.

c. **Conscientiousness:** The team's score was low (0 percentile). The team reflects signs of being ineffective, lack of goals, lack of cooperation and organization, counterproductive behavior, and low job satisfaction.

d. **Neuroticism:** The team's score was high (85.70 percentile). The team reflects signs of reduced team cohesiveness, disruption of task coordination due to ill-temper, high levels of disagreement, anti-social team environment, and higher impulsive behavior which hurts communication.

e. **Open to Experience:** The team's score was low (0 percentile). The team reflects signs of lack of creative solutions, sticking to stablished methods, struggle to resolve issues, team feeling threatened by new methods, avoiding open discussion, and not being flexible towards changes which affect adaptation.

8. Case Study XK9DJ:
    a. **Extraversion:** The team's score was high (100 percentile). The reflects signs of team cohesiveness, higher communication, and higher coordination.
    b. **Agreeableness:** The team's score was high (71.40 percentile). The team reflects signs of high vitality, concern for team success over personal, trust among team members, better conflict resolution, open communication, flexibility towards changes, team members working well with each other, and less competition among team members.
    c. **Conscientiousness:** The team's score was low (14.20 percentile). The team reflects signs of being engaged in goals or planning goals, performing tasks in detail, enthusiasm with team members, high levels of organization, higher job satisfaction, and higher levels of productive behavior.
    d. **Neuroticism:** The team's score was average (42.80 percentile). The team is more on the low side of the spectrum. The team reflects some signs of team cohesiveness, effective decision making, high conflict management, high levels of cooperation, more open communication, being emotionally stable during discussions, and a peaceful team environment.
    e. **Open to Experience:** The team's score was high (71.40 percentile). The team reflects signs of generating noble solutions, not avoiding conflict and approaching conflict with collaboration, high flexibility to changes, higher levels of adaptation, and promoting open discussions.
    f.

4.12 Scoring Team Performance Questionnaire

The TPQ was scored using the *scoreItem* command in RStudio and transported to MS Excel to calculate percentile scores. The percentile scores are represented as low, average, and high team performance, where low scores are below the 25th percentile, average scores are between the 25th and 75th percentile, and high scores are above the 75th percentile (for the raw and percentile scores see appendix XIX and appendix X, respectively). The individual percentile scores were calculated using the percent rank function in MS Excel, based on the mean and standard deviation of the sampled cases (n = 39). The team level percentile scores were calculated similarly, but the mean for each condition was calculated first, followed by the applicaiton of the percent rank function to get percentiles. Individual performance was calculated by obtaining the mean score of all the conditions combined for each team member and the percentiles were calculated based on that mean. Team performance for team level was calculated by obtaining the mean of all the conditions combined for each case study team and the percentiles were calculated based on that mean. Table 4.17 below details the percentile scores based on the relative position of all sampled case studies by individual and team level.

Table 4.17. Team Performance Score by Individuals, Teams, and Overall Score

n	**Code**	**Evaluated Member**	**Individual Level n = 32**						**Team Level n = 8**					
			TMS	**SVGC**	**CRP**	**CIS**	**TRP**	**Ind. Perfct.**	**TMS**	**SVGC**	**CRP**	**CIS**	**TRP**	**TP Perct.**
1	0AQD7	GC	Low	Low	Avg	Low	Low	**0.16**	Avg	Low	Avg	Avg	Avg	**0.57**
2	0AQD7	Owner	Avg	Avg	Avg	Avg	Avg	**0.68**						
3	0AQD7	Owner	High	Avg	Avg	Avg	Avg	**0.68**						
4	0AQD7	GC	Avg	Avg	Avg	Low	Avg	**0.37**						
5	4DH7W	Owner	Avg	High	High	Avg	Avg	**0.76**	Low	Avg	Low	Avg	Avg	**0.29**
6	4DH7W	Owner	Avg	Avg	Avg	Avg	Avg	**0.55**						
7	4DH7W	Owner	Low	Low	Low	Low	Low	**0.05**						
8	4DH7W	GC	Low	Low	Low	Low	Low	**0.13**						
9	4DH7W	Owner	Avg	Avg	Low	Avg	Avg	**0.53**						
10	59HQR	Owner	High	Avg	High	Avg	Avg	**0.84**	High	High	High	High	High	**1.00**
11	59HQR	GC	High	High	High	Avg	Avg	**0.74**						
12	59HQR	Owner	High	High	High	Avg	Avg	**0.95**						
13	59HQR	GC	Avg	High	High	Avg	Avg	**0.87**						
14	59HQR	Owner	Avg	Avg	High	Avg	Avg	**0.76**						
15	59HQR	Owner	High	Avg	Avg	Avg	Avg	**0.63**						
16	59HQR	GC	Avg	Low	Avg	Avg	Low	**0.24**						
17	59HQR	GC	Low	Avg	Avg	Avg	Avg	**0.34**						
18	5M2N7	GC	Low	Avg	Avg	Low	Avg	**0.32**	Avg	Avg	Avg	Low	Avg	**0.43**
19	5M2N7	Owner	High	High	High	Avg	Avg	**0.95**						
20	5M2N7	GC	Low	Avg	Low	Low	Avg	**0.18**						
21	9BW2Q	GC	Avg	Avg	Avg	Avg	Avg	**0.37**	Avg	Avg	Avg	Low	Low	**0.14**
22	9BW2Q	GC	High	High	High	Avg	Avg	**0.92**						
23	9BW2Q	GC	Avg	Avg	Low	Low	Low	**0.26**						

Table 4.17 Continued.

n	Code	Evaluated Member	Individual Level n = 32						Team Level n = 8					
			TMS	SVGC	CRP	CIS	TRP	Ind. Perfct.	TMS	SVGC	CRP	CIS	TRP	TP Perct.
24	9BW2Q	Owner	Low	Avg	Avg	Avg	Avg	**0.45**						
25	9BW2Q	Owner	High	Avg	High	Avg	Avg	**0.89**						
26	9BW2Q	GC	Low	Low	Avg	Low	Low	**0.11**						
27	9BW2Q	GC	Low	Low	Low	Low	Low	**0.00**						
28	Q97Y2	Owner	Low	Low	Low	Avg	Low	**0.05**	Low	Low	Low	Avg	Low	**0.00**
29	Q97Y2	GC	Low	Low	Low	Low	Low	**0.03**						
30	Q97Y2	GC	Avg	Avg	Avg	Avg	Avg	**0.61**						
31	Q97Y2	Owner	Avg	Low	Avg	Avg	Avg	**0.50**						
32	TW1RK	Owner	Low	Low	Avg	Avg	Low	**0.29**	Avg	High	High	Avg	Avg	**0.71**
33	TW1RK	GC	Avg	Avg	Avg	Avg	Avg	**0.58**						
34	TW1RK	Owner	Avg	Avg	Avg	Low	Avg	**0.45**						
35	TW1RK	Owner	Avg	High	Avg	Avg	Avg	**0.82**						
36	XK9DJ	Owner	Avg	Avg	Low	Avg	Avg	**0.42**	High	Avg	Avg	Avg	Avg	**0.86**
37	XK9DJ	GC	Low	Avg	Low	Low	Low	**0.18**						
38	XK9DJ	Owner	High	High	High	Avg	Avg	**0.95**						
39	XK9DJ	Owner	High	Avg	Avg	Avg	Avg	**0.63**						

Next, Table 4.18 below details the interpretation of team performance at the team level, from low to high team performance; the scores were used for the QCA. For more details, see the section on “Selection of the Team Performance Questionnaire (TPQ)” in Chapter 3.

- Low team performance: Team performance needs considerable improvement, suggesting lower levels of success (Not meeting expectations and cause for concern)
- Average team performance: Team performance is satisfactory but could be improved, suggesting moderate levels of success.
- High team performance: Team performance needs considerable improvement, suggesting lower levels of success (Not meeting expectations and cause for concern)

Table 4.18. Team Performance Scores by Case Study (Team Level)

Low Team Performance (0 to 0.25)		Average Team Performance (0.26 to 0.74)		High Team Performance (0.75 to 1.0)	
Case	**Score**	**Case**	**Score**	**Case**	**Score**
Q97Y2	0.00	4DH7W	0.29	TW1RK	0.71
9BW2Q	0.14	5M2N7	0.43	XK9DJ	0.86
		0AQD7	0.57	59HQR	1.00

4.13 Qualitative Comparative Analysis

QCA analysis was conducted in order to determine (a) which among the hypothesized predictors of team performance were necessary for high team performance, and (b) the best combinations of the predictor variables sufficient for high team performance. The internal consistency for the personality and team performance questionnaires revealed 12 variables fit for the QCA: TPO, TSV, TMS, SVGC, CRP, CIS, TRP, EX, AG, CO, NE, and OP. However, QCA could not run all 12 conditions due to computing power. Therefore, TPO andTSV were removed from any further analysis. TPO and TSV were chosen because they had the least number of sources (two sources) compared to TMS, SVGC, CRP, CIS, and TRP (five plus sources). Another reason why TPO and TSV were removed had to do with number of conditions compared to total number of cases (Ragin, 2009). The combination of the conditions increases exponentially as more conditions are added. Since the number of cases per individuals (n = 39) and per case studies (n = 8) is too small to for 12 variables. According to Ragin (2009) and Devers et al. (2013) there could be an issue with limited diversity since the total number of combinations (4,096 possible combinations for 12 conditions) are much larger than the case studies.

Prior to conducting the actual analysis, fuzzification was done to convert the raw dataset values into fuzzy scores between 0 and 1. Notably, a total of ten fuzzy conditions were used in the QCA analysis. Out of the ten fuzzy conditions, five were extracted from team criteria: TMS, SVGC, CRP, CIS, and TRP. Similarly, five fuzzy conditions were extracted from personality; EX, AG, CO, NE, and OP. Calibration of the personality conditions was conducted using thresholds determined directly from the case studies' relative scores among all case studies (percentile scores). The percentile scores at 31st, 50th, and 70th were extracted for each condition, and were used for the exclusion, crossover point, and inclusion threshold for the calibration process (see Table 4.19). Appendix XI contains fuzzification results.

Table 4.19. Inclusion, Exclusion, and Crossover Values for Calibration of Personalities

Level	**Threshold**	**EX**	**AG**	**CO**	**NE**	**OP**
Individuals	Exclusion	0.30	0.29	0.31	0.68	0.30
	Crossover	0.50	0.50	0.45	0.39	0.34
	Inclusion	0.66	0.63	0.68	0.26	0.68
Teams	Exclusion	0.31	0.31	0.31	0.70	0.31
	Crossover	0.50	0.50	0.50	0.50	0.50
	Inclusion	0.70	0.70	0.70	0.31	0.70

The mean score of the team criteria conditions was used as the crossover point while the 25th and 75th percentiles were selected as lower and upper thresholds, respectively. Particularly, values below the 25th percentile were in the exclusion range, while values above the 75th percentile were in the inclusion range. After fuzzification of the conditions, the data was first written on to Excel sheets and consolidated into a dataset for the QCA analysis. Details of the fuzzification results can be found in Appendix XII. See Table 4.20 for threshold points. After calibration, the analysis of necessity and sufficiency can be performed.

Table 4.20. Inclusion, Exclusion, and Crossover Values for Calibration of Team Criteria

Level	Threshold	TMS	SVGC	CRP	CIS	TRP	TP
Individuals	Exclusion	0.24	0.25	0.22	0.24	0.21	0.24
	Crossover	0.50	0.50	0.29	0.50	0.50	0.50
	Inclusion	0.71	0.66	0.75	0.68	0.71	0.71
Teams	Exclusion	0.25	0.25	0.25	0.25	0.25	0.25
	Crossover	0.50	0.50	0.50	0.50	0.50	0.50
	Inclusion	0.75	0.75	0.75	0.71	0.71	0.75

4.13.1 Internal Validity of QCA Parameters

See the section regarding "Internal Validity" under "QCA Internal validity" for more information on the cut-off thresholds that was accessed with the following thresholds:

4.13.2 Analysis of Necessity – Individual Team Members

Analysis of necessity was conducted on the calibrated dataset. The dataset was defined as shown in appendix XI and XII, where "Calibrated" represents the fuzzy dataset. For the analysis of necessity, the *superSubset()* function was used. For more details on the analysis of necessity, refer to the section "Step Four: Calibration process and Analysis of Necessity" in Chapter 3. Also, for internal validity of QCA, see the section "Internal Validity" under "QCA Internal validity" for more information on the cut-off thresholds that were used to access QCA internal validity. Here are a few clarifications to help readers understand the analysis of necessity:

- The plus symbol "+" indicates "or". It implies that either condition in the expression (example A+B) is just as necessary on their own as their combination. It is also known as a disjunction.
- The asterisk symbol "*" indicates "and". It implies that A and B (A*B) must be present for the outcome to happen. It is also known as conjunction.
- Trivial: Conditions or configuration of conditions that have little value to the relevance of necessity (RoN).
- Non-trivial: Conditions or configuration of conditions that have more value to relevance of necessity. RoN is directly affected by coverage. The higher the coverage, the more relevant the conditions or configuration of conditions become.
- To access relevance of necessity (the further away from zero, the better (Ragin 2000)): RoN scores below 0.50 were considered trivial and RoN scores from 0.50 were considered non-trivial. However, RoN scores above 0.80 were considered more relevant to high or low team performance in this research.

4.13.3 Analysis of Necessity for Personality Traits and Team Criteria

The output consists of 86 configurations obtained from the analysis of necessity for team criteria and personality combined. For clarity, Table 4.21 only contains configurations with a relevance of necessity score greater than 0.50. The analysis for necessity revealed two single conditions with high inclusion: relevance of necessity, and high coverage. The analysis also revealed several configurations composed of two conditions and up to four conditions with high estimates of inclusion (>0.90).

Table 4.21. Analysis of Necessity Results High Team Performance

No.	Configuration	inclN	RoN	covN
1	TRP	0.93	0.96*	0.95*
2	TMS+CIS	0.95	0.85*	0.86*
3	TMS+SVGC	0.98	0.83*	0.84*
4	SVGC+CIS	0.98	0.80*	0.82*
5	CRP	0.92	0.79*	0.80*
6	AG+TMS	0.96	0.64	0.71

Table 4.21 Continue

No.	Configuration	inclN	RoN	covN
7	CO+TMS	0.96	0.64	0.71
8	AG+CIS	0.97	0.61	0.70
9	AG+SVGC	0.92	0.64	0.70
10	CO+CIS	0.95	0.60	0.69
11	CO+SVGC	0.97	0.58	0.69
12	~NE+TMS	0.97	0.54	0.67
13	~NE+SVGC	0.93	0.57	0.66
14	~NE+CIS	0.97	0.53	0.66
15	~EX+TMS	0.96	0.52	0.65
16	~EX+CIS	0.97	0.51	0.65
17	OP+TMS	0.94	0.53	0.65
18	~EX+SVGC	0.93	0.54	0.65
19	OP+CIS	0.95	0.52	0.65
20	OP+SVGC	0.96	0.51	0.65
21	~OP+TMS	0.93	0.52	0.64
22	~OP+CIS	0.90	0.53	0.63
23	EX+TMS	0.92	0.51	0.63
24	NE+TMS	0.91	0.52	0.63

Note: See Appendix XIII for full table. This table only includes configurations with a RoN > 0.50. The asterisk (*) indicates the configuration has good internal consistency.

The first configuration consisted of only TRP, with an inclusion score of 0.93, which indicates that 93.0% of the first configuration is included in the outcome set. The results then imply that the presence of TRP in a construction team is necessary or almost necessary for high team performance to occur. Additionally, the first model also has a high relevance score (RoN = 0.96), indicating the configuration is non-trivial. Lastly, the first configuration (TRP) explains a high proportion of variation in team performance with a coverage score of 0.95, explaining 95.0% of the variation in team performance. Figure 4.12 illustrated the XY-plot for a visual representation of TRP necessity relation to team performance.

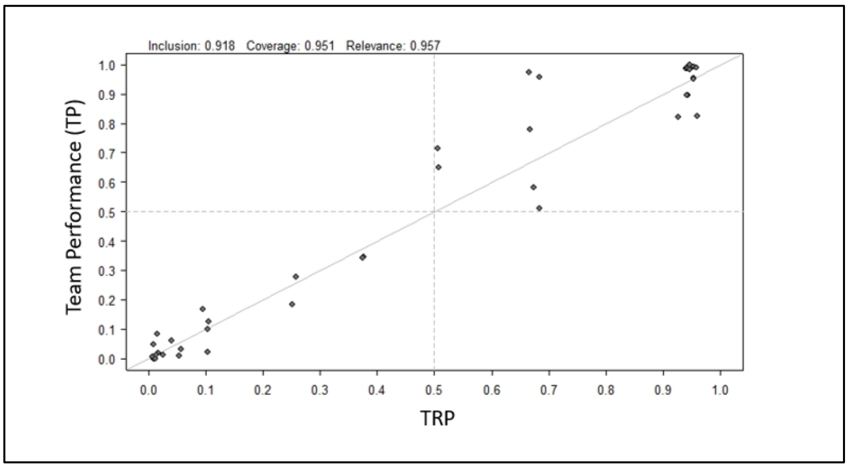

Figure 4.12. Necessity Relation of TRP to Team Performance

The second configuration consisted of TMS+CIS (presence of team member satisfaction or communication and information sharing). Therefore, the presence of either TMS or CIS are necessary or almost necessary conditions for high team performance with a high score on inclusion of necessity (inclN = 0.95), relevance of necessity (RoN = 0.85), and coverage of necessity (covN = 0.86). As such, the model is relevant and explains 85.0% of variation in team performance, making this configuration non-trivial. Figure 4.13 presents the XY-plot for a visual representation of TMS + CIS necessity relation to team performance.

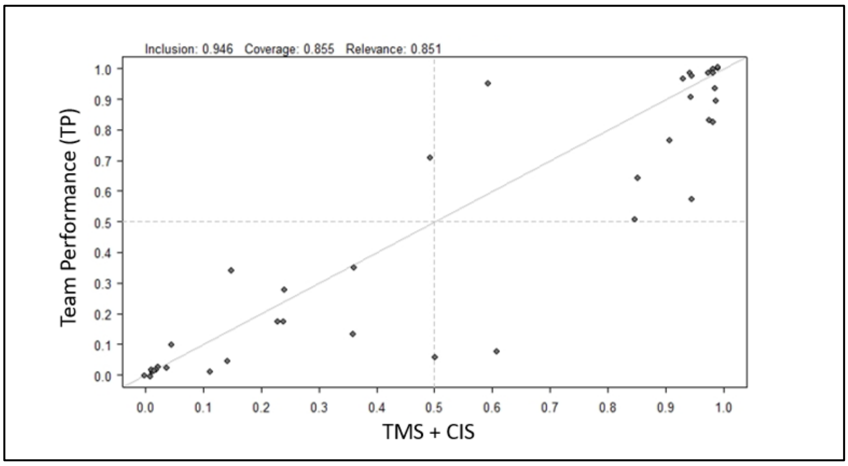

Figure 4.13. Necessity Relation of TMS + CIS to Team Performance

The third configuration consisted of TMS+SVGC (presence of team member satisfaction or shared values, goals, and culture). Therefore, these results show that the presence of either TMS or SVGC are necessary or almost necessary conditions for high team performance. The configuration has a high inclusion score (inclN = 0.98) indicating a large proportion of the configuration exists in the high team performance set. Additionally, the third configuration has an acceptable relevance score (RoN = 0.83), indicating that the configuration is relevant and non-trivial. The third configuration also has a high coverage score (covN = 0.84). As such, the model is relevant and explains 84.0% of variation in team performance. See Figure 4.14 a XY-plot for a visual representation of TMS + SVGC necessity relation to team performance.

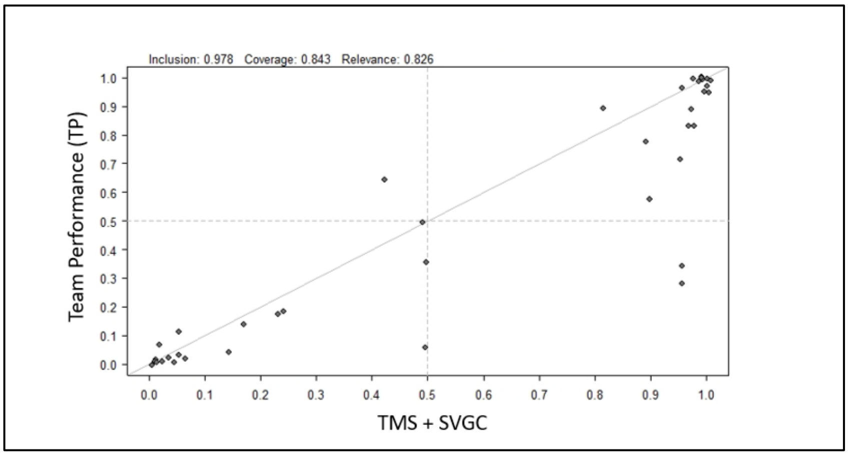

Figure 4.14. Necessity Relation of TMS + SVGC to Team Performance

The fourth configuration consisted of SVGC+CIS (presence of shared values, goals, and culture, or communication and information sharing). These results mean that the presence of either SVGC or CIS are necessary or almost necessary conditions for high team performance. The configuration is the highest for the inclusion estimate with a score of 98.0%, indicating that a large proportion of the configuration exists in the set team performance. The fourth configuration is very close to 0.80. Thus, it was considered as an acceptable relevance score (RoN = 0.80), indicating that the configuration is relevant and non-trivial. The third configuration also has a high coverage score (covN = 0.82). As such, the model is relevant and explains 82.0% of the variation in team performance. Figure 4.15 shows the XY-plot for a visual representation of SVGC + CIS necessity relation to team performance.

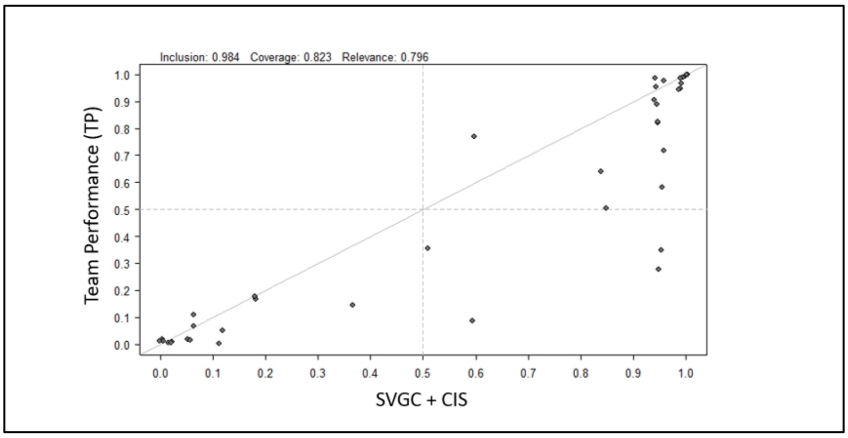

Figure 4.15. Necessity Relation of SVGC + CIS to Team Performance

The fifth configuration in the analysis of necessity consisted of only one condition, CRP (commitment and responsibility). As such, CRP alone are necessary or almost necessary for high team performance with a high inclusion score (inclN = 0.92). The fifth configuration also has a score very close to 0.80. Thus, it was considered as an acceptable relevance score (RoN = 0.79), indicating that the configuration is relevant and non-trivial. CRP coverage score is high (covN = 0.80), and so, the model is relevant and explains 80.0% of variation in team performance. Figure 4.16 provides the XY-plot for a visual representation of CRP necessity relation to team performance.

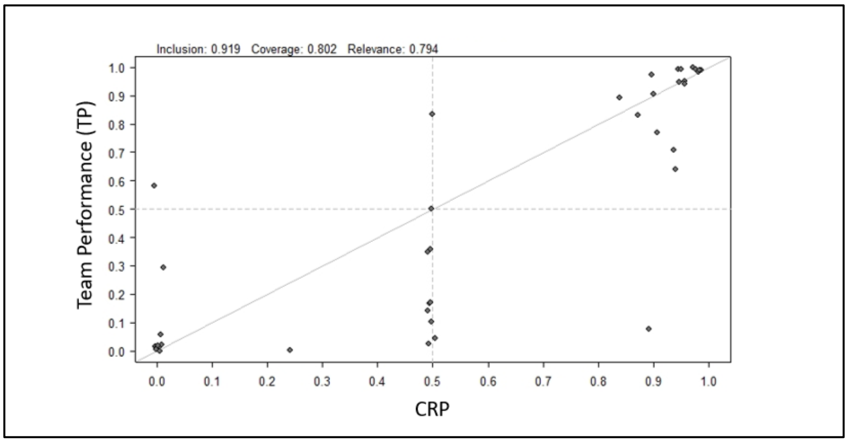

Figure 4.16. Necessity Relation of CRP to Team Performance

Personality traits combined with team criteria revealed that personality traits are necessary or almost necessary for high team performance since their inclusion score is greater than 0.90. Personality traits were considered non-trivial for team performance since the RoN scores were above 0.50 in the configurations where they are present. Table 4.21 above contains 24 configurations and 19 of them have at least one personality trait (one personality or one team criteria) that have a relevance of necessity score greater than 0.50 with a coverage greater than 0.63. It is consistent with Q3 since all five personality traits (present or absent) are included in the analysis of necessity. Though personality traits in disjunction with team criteria do not have relevance scores above 0.80, their presence or absence does have an influence on team performance. It can be observed that from the 19 configurations of personality traits with team criteria, revolved around three team criteria conditions: TMS, communication and information sharing, and shared values, goals, and culture. The analysis also revealed that the personality traits of AG and CO are the top two traits that have a relevance greater than 0.60 and coverage greater than 0.69. For example, the configuration of AG + TMS (presence of agreeableness or team member satisfaction) is 95.5% present in the outcome and explains 71.3% of the variation in team performance. Therefore, there is a 4.5% chance of observing high team performance without observing agreeableness or TMS. It is not a perfect (100%) necessity, which means that it is not impossible for AG + TMS not to be present in team performance, however unlikely. The same analogy is applied to the rest of the configurations.

4.13.4 Negative Team Performance Personality Traits and Team Criteria

It is important to observe which of the conditions (or combinations) are necessary for negative team performance. For this research, negative team performance is considered as low team performance and has scores below the 25th percentile. The cut-off values are the same when analyzing necessity for positive team performance. In the *superSubset()* function, the *negOut()* function is set to *True* to observed negative outcomes.

The output consisted of 111 possible configurations that lead to low team performance. For clarity, Table 4.22 contains configurations with a relevance of necessity score greater than 0.50. The rest of the configurations were below 0.50 and can be found in Appendix XIV. This does not mean the rest of the configurations are not important as the other configurations may manifest negative team performance. However, this research is interested in the configurations with higher relevance and coverage that lead to low team performance. The analysis for necessity considering low team performance revealed two single conditions (no. 1 and 2 in Table 4.19) with high inclusion, relevance of necessity, and high coverage. The analysis also revealed several configurations composed of two conditions (39 configurations), three conditions (20 configurations), four conditions (42 configurations) and five conditions (8 configurations). However, only 18 configurations composed of two single conditions and 16 configurations of two conditions had higher relevance of necessity to produce low team performance, Table 4.22.

Table 4.22. Analysis of Necessity Results for Low Team Performance

No.	Confg.	inclN	RoN	covN
1	~TRP	0.95	0.92*	0.92*
2	~TMS	0.92	0.90*	0.90*
3	~CRP+~CIS	0.95	0.81*	0.83*
4	~SVGC+~CRP	0.97	0.80*	0.83*
5	~SVGC+~CIS	0.99	0.74	0.80*
6	~CO+~CRP	0.92	0.67	0.73
7	~AG+~SVGC	0.94	0.63	0.71
8	NE+~CRP	0.91	0.65	0.71
9	~CO+~CIS	0.96	0.61	0.71
10	~CO+~SVGC	0.98	0.59	0.71
11	~AG+~CRP	0.92	0.62	0.70
12	NE+~SVGC	0.95	0.60	0.70
13	~OP+~CRP	0.91	0.62	0.69
14	~AG+~CIS	0.95	0.58	0.69
15	~OP+~SVGC	0.95	0.58	0.69
16	~OP+~CIS	0.94	0.58	0.68
17	NE+~CIS	0.96	0.55	0.68
18	EX+~SVGC	0.95	0.54	0.67

Note: See Appendix XIV for full table. This table only includes configurations with a RoN > 0.50. The asterisk (*) indicates the configuration has good internal consistency.

The first two configurations consist of ~TRP (absence of trust and respect) and ~TMS (absence of team member satisfaction). The absence of trust and respect has a 95.0% chance of producing low team performance, while the absence of TMS has a 92.0% chance of leading to low team performance. Furthermore, the relevance of necessity means that the absence of trust and respect, and TMS are considered necessary to produce low team performance (RoN = 0.92 and 0.90 respectively) and to be considered non-trivial. Figure 4.17 illustrates the XY-plot for ~TRP and Figure 4.18 shows the XY-plot for ~TMS.

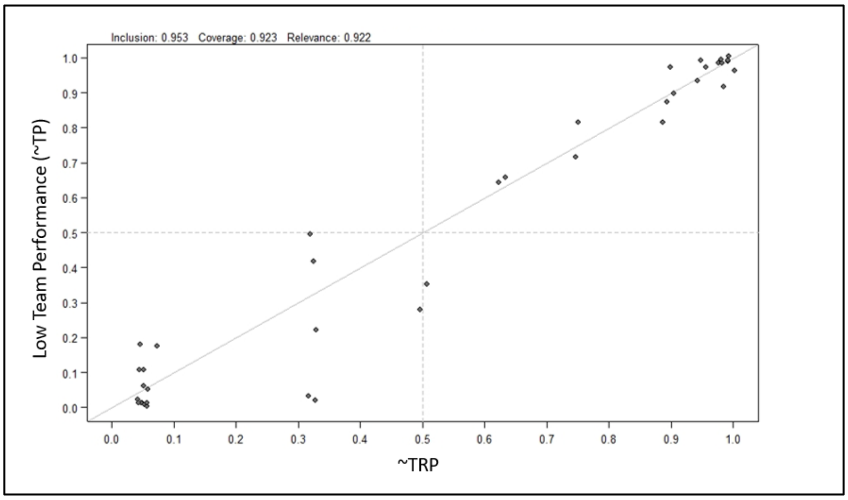

Figure 4.17. Necessity Relation of ~TRP to Negative Team Performance

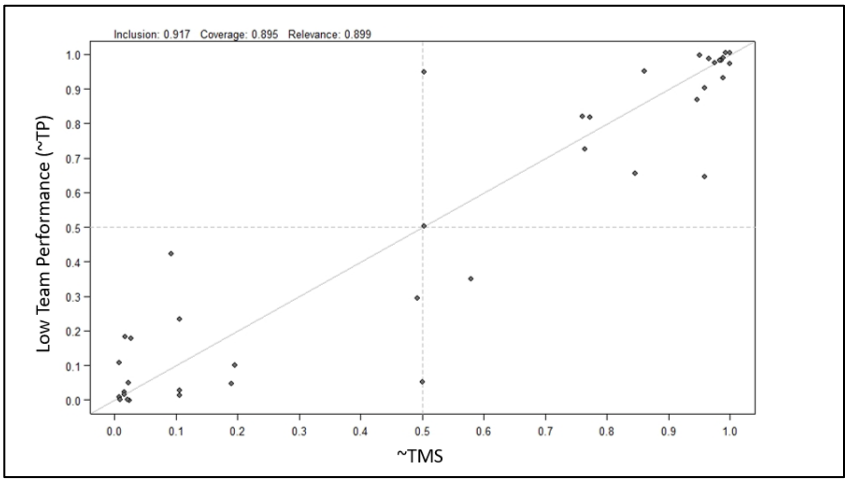

Figure 4.18. Necessity Relation of ~TMS to Negative Team Performance

One interesting observation between high and low team performance is that TMS was not present by itself for high team performance, but was present in 13 other combinations with other conditions (See Table 4.21), such as:

- TMS + CIS, which means the presence of team member satisfaction or the presence communication and information sharing leads to high team performance.
- TMS + SVGC, which means that the presence of team member satisfaction or the presence of shared values, goals, and culture leads to high team performance.

- AG + TMS, which means that the presence of agreeableness or the presence of team member satisfaction leads to high team performance.
- CO + TMS, the presence of conscientiousness or team member satisfaction leads to high team performance.
- ~NE + TMS, which means the absence of neuroticism, or the presence of team member satisfaction leads to high team performance.
- ~EX + TMS, the absence of neuroticism or the presence of team member satisfaction leads to high team performance

It makes sense why the absence of TMSwould cause low team performance, because it appears in so many combinations in a high team performance, as a necessary or almost necessary condition for high team performance.

Additionally, the analysis of necessity revealed that the absence of TMS, CIS, SVGC, CRP, and TRP leads to producing low team performance based on their inclusion, relevance, and coverage estimate scores. The highest inclusion estimate score belongs to the configuration ~SVGC + ~CIS (absence of shared values, goals, and culture or absence of communication and information sharing), which has 99.0% presence score, 74.0% relevance score, and coverage of 80.0% of the variation in low team performance. However, the absence of TRP or the absence TMS alone have higher relevance and coverage scores than the rest of the configurations in Table 4.22 for low team performance.

There is no evidence that personality traits cause low team performance since they do not appear on their own in a negative team performance. However, personality traits combined with team criteria produces different outcomes. It was observed that the absence of any of the personality traits in combination with team criteria are highly likely to produce low team performance. For example, there are nine configurations in Table 4.22 with high scores (inclN > 0.90, RoN > 0.50 and covN > 0.65) where the ~CO, ~AG, and ~OP (absence of conscientiousness, agreeableness, and openness) are found in combination with the absence of team criteria that produces low team performance. Special attention was made to NE and EX. It was revealed that high scores of EX or NE were linked to low team performance in configurations with low scores of team criteria (or absence). Some of these configurations are discussed below.

In the configurations NE + ~CRP (presence of neuroticism or the absence of commitment and responsibility), and NE + ~SVGC (presence of neuroticism or absence of shared values, goals, and culture), the results indicate that 91.4% and 94.7% of the time, respectively, the presence of NE and the absence of CRP or SVGC is included in the outcome for low team performance. As a reminder, the presence of NE in this configuration indicates that the team member's score for NE is higher than the mean, and higher scores of NE are not favorable. The configuration also indicates the relevance score (RoN = 0.647 and 0.599, respectively), which shows that the configuration may or may not be non-trivial. Lastly, the configuration coverage score (covN = 0.708 and 0.696, respectively) explains 70.8% and 69.6% of the variation in low team performance. It implies that if high scores of NE are observed in team members, then high scores of CRP, and SVGC need to be present to avoid low team performance.

Finally, in the configuration EX + ~SVGC (presence of extraversion and absence of shared values, goals, and culture), the results indicate that 95.0% of the time, the presence of EX or the absence of SVGC potentially lead to low team performance. The configuration had a 54.0% relevance to team performance with a score (RoN = 0.54), indicating that the configuration is non-trivial. Lastly, the configuration coverage score (covN = 0.67) explains 67.0% of low team performance variation. It implies that if high scores of extraversion are observed in team members, a high score of shared values, goals, and culture needs to be observed to avoid low team performance.

4.13.5 Analysis of Necessity – Teams

Analysis of necessity was conducted to determine the conditions (and combinations of conditions) necessary for high team performance at the individual and team level. The data framework was defined as shown in appendix XV, along with the fuzzified dataset. This section contains the results for the analysis of necessity for teams. The cut-off figures for the *superSubset()* function will remain the same when evaluating high team performance at the individual level.

4.13.6 Analysis of Necessity for Personality Traits and Team Criteria

The output consists of 86 configurations obtained from the analysis of necessity for team criteria and personality, using teams as the sample size. However, only 18 configurations were revealed by the analysis with relevance of necessity scores ranging from 0.52 to 0.94 and coverage ranging from 0.64 to 0.94 (See Table 4.23). The analysis of necessity revealed one single condition with high inclusion, relevance of necessity, and high coverage. The analysis also revealed several configurations composed of two conditions (16 configurations) and three conditions (1 configuration) with high estimates of inclusion (>0.90).

Table 4.23. Analysis of Necessity Results for High Team Performance (Teams)

No.	Confg.	inclN	RoN	covN
1	TRP	0.94	0.94	0.94
2	TMS+SVGC	1.00	0.66	0.75
3	TMS+CRP	0.99	0.61	0.71
4	TMS+CIS	1.00	0.59	0.71
5	AG+SVGC	0.99	0.59	0.71
6	OP+SVGC	0.99	0.56	0.69
7	~EX+CIS	0.99	0.56	0.69
8	AG+CRP	0.99	0.53	0.68
9	AG+CIS	0.93	0.59	0.68
10	OP+CRP	0.98	0.52	0.67
11	~EX+SVGC	0.99	0.50	0.66
12	OP+CIS	0.93	0.55	0.66
13	~EX+NE	0.94	0.53	0.65
14	~CO+CRP	0.90	0.56	0.65
15	~EX+CRP	0.93	0.54	0.65
16	~CO+SVGC+CIS	0.90	0.55	0.65
17	EX+~NE	0.91	0.53	0.64
18	~NE+OP	0.91	0.52	0.64

Note: See Appendix XVI for full table. This table only includes configurations with a RoN > 0.50. The asterisk (*) indicates the configuration has good internal consistency

The first configuration consists of only TRP (presence of trust and respect), with an inclusion score of 0.941. As such, the results indicate that TRP is included in the outcome set, implying that it is necessary or almost necessary for high team performance. Additionally, the first model also has a high relevance score (RoN = 0.940), indicating that the configuration is non-trivial. Lastly, the first configuration of TRP explains a high proportion of variation in team performance with a coverage score of 0.937, explaining 93.7% of the variation in high team performance. Figure 4.19 shows the XY-plot for a visual representation of TRP necessity relation to team performance. Like the results at the individual level, TRP is the condition that repeatedly manifests as a single condition to be necessary or almost necessary for team performance.

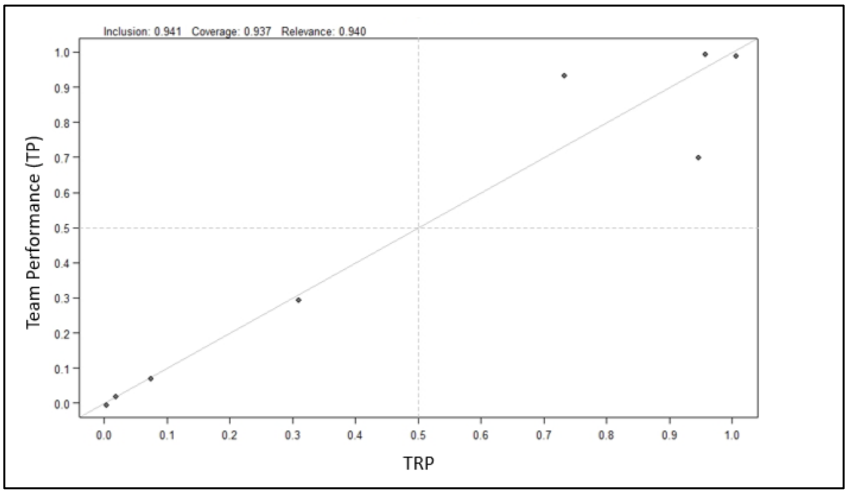

Figure 4.19. Necessity Relation of TRP to TP (n = 8 teams)

At the individual level, CRP (presence of commitment and responsibility) appeared as a single condition but not at the team level. However, CRP (at team level) appeared in several configurations with high inclusion, and relevance of necessity, and coverages greater than 60.0% (see configurations number 3, 8, 110, 14, and 15 in Table 4.23). Despite the team level having a much smaller sample size, the analysis of necessity revealed that the presence of TMS, CIS, SVGC, and CRP had relevance (min RoN = 0.50, max RoN = 0.66) to high team performance with good coverages between 63.5% to 74.5%. It indicates that their presence is relevant and could be considered non-trivial. The scores are not as high as they are at the individual level, but this is most likely due to the low sample size. The difference in sample size could also indicate the reason why some of the configurations at the team level are different from those at the individual level. Furthermore, Table 4.24 details the configurations that were similar between individual and team levels, and how their differences in the score were affected due to sample size differences. However, TRP was unaffected by sample size, which indicated how important TRP was for high team performance (See Table 4.24).

Table 4.24. Analysis of Necessity: Illustrating Scores Differences Between Teams and Individuals

No.	Confg.	Teams (n = 8)			Individuals (n = 39)			p-value	p-value	p-value
		inclN	RoN	covN	inclN	RoN	covN	inclN	RoN	covN
1	TRP	0.94	0.94	0.94	0.92	0.96	0.95	0.099	0.802	0.644
2	TMS+SVGC	1.00	0.66	0.75	0.98	0.83	0.84	0.114	0.013*	0.001*
3	TMS+CIS	1.00	0.59	0.71	0.95	0.85	0.86	0.000*	0.000*	0.000*
4	AG+SVGC	0.99	0.59	0.71	0.92	0.64	0.70	0.000*	0.469	0.767
5	AG+CIS	0.93	0.59	0.68	0.97	0.61	0.70	0.000*	0.768	0.448
6	CO+CIS	0.98	0.35	0.6	0.95	0.60	0.69	0.073	0.000*	0.002*
7	OP+SVGC	0.99	0.56	0.69	0.96	0.51	0.65	0.018	0.434	0.138
8	~EX+SVGC	0.99	0.50	0.66	0.93	0.54	0.65	0.000*	0.497	0.741
9	~NE+TMS	0.99	0.45	0.64	0.97	0.54	0.67	0.222	0.165	0.339
	Sample std.dev.	*0.037888*	*0.171552*	*0.074964*	*0.023765*	*0.188063*	*0.091794*			

Note: This table only includes configurations in which individual and team level had similar conditions combined. Sample standard.deviation. was calculated from the 86 different configurations obtained for team and individual datasets in the analysis of necessity

Regarding personality traits, none of the traits appeared as a single condition in the analysis of necessity for teams. However, personality traits do appear in configurations with team criteria as they did in the individual level analysis. Similar to the individual level resultspresence of AG and openness was found at the team level as well for a medium relevance of necessity on team performance,. In Table 4.24, configurations AG+SVGC (presence of agreeableness or shared values, goals, and culture), AG+CIS (presence of agreeableness or communication and information sharing), and OP+SVGC (presence of openness to experiences or shared values, goals, and culture) show differences in the inclusion scores (p-values 0.0000*, 0.0051*, 0.0178*) but there were no differences found in the relevance and coverage for necessity. At the individual level, the presence of CO demonstrated to be relevant with a RoN score greater than 0.584. However, the opposite was found at the team-level analysis. The absence of conscientiousness appeared to be relevant with a RoN score greater than 0.552. The presence of conscientiousness at the team level only has RoN score of 0.40. Furthermore, differences in scores were observed only in the RoN and coverage between conscientiousness at the individual and team levels.

When it comes to extraversion and neuroticism in both the individual and at team levels, their absence is more relevant to high team performance, with no differences in their RoN and coverage scores. The configurations OP+SVGC (presence of openness or presence of shared values, goals, and culture) and ~EX+SVGC (absence of extraversion or the presence of shared values, goals, and culture) showed differences in the inclusion scores (p-values = 0.0178* and 0.0000*). However, their scores are still above the 0.90 inclusion cut-off, and their differences in the score are not considered an issue. Differences in the RoN and coverage scores could be considered troublesome since it deals more with sample size. This can be seen in the configurations TMS+SVGC (presence of team member satisfaction or the presence of shared values, goals, and culture), TMS+CIS (presence of team member satisfaction or presence of communication and information sharing, and CO+CIS (presence of conscientiousness and presence of communication and information sharing) shown in Table 4.24. Since teams are composed of averaged scores from the individual scores, the presence and absence of the conditions are reduced from 39 team members to eight cases studies or teams, which directly affects coverage, and coverage directly affects relevance of necessity. It implies that the team sample size needs to increase to access the findings at the team level.

4.13.7 Negative Team Performance Personality Traits and Team Criteria

The output (see Table 4.25) consists of 28 possible configurations that lead to low team performance. However, this research is interested in the configurations with higher relevance and coverage that lead to low team performance. The analysis for necessity considering low team performance at the team level revealed one single condition with high inclusion, relevance of necessity, and high coverage. The analysis also revealed several configurations composed of two conditions with high estimates of inclusion (>0.90). However, only 19 configurations composed of one single condition and 18 configurations of two conditions, had higher relevance of necessity to produce low team performance.

Table 4.25. Analysis of Necessity Results for Low Team Performance (Teams)

No.	Confg.	inclN	RoN	covN
1	~TRP	0.94	0.95*	0.94*
2	~SVGC+~CIS	0.99	0.74	0.79*
3	~CRP+~CIS	0.99	0.74	0.79*
4	~OP+~TMS	0.93	0.70	0.74
5	~AG+~OP	0.93	0.70	0.74
6	~TMS+~CRP	0.99	0.61	0.71
7	~TMS+~CIS	1.00	0.59	0.71
8	~NE+~TMS	1.00	0.58	0.71
9	~AG+~CIS	0.96	0.60	0.70
10	~OP+~CIS	0.98	0.58	0.70
11	~TMS+~SVGC	0.93	0.61	0.69
12	~AG+~NE	0.96	0.55	0.67
13	~AG+~CRP	0.99	0.52	0.67
14	~NE+~OP	0.99	0.52	0.67
15	~OP+~CRP	0.99	0.52	0.67
16	~NE+~SVGC	0.90	0.58	0.66
17	~AG+~SVGC	0.93	0.55	0.66
18	~OP+~SVGC	0.94	0.53	0.65
19	~EX+~SVGC	0.93	0.53	0.65
20	~EX+~NE	0.99	0.45	0.64
21	~EX+~CIS	0.98	0.45	0.64
22	~EX+~CRP	0.99	0.44	0.63
23	EX+NE	0.96	0.44	0.62
24	~CO+~CRP	0.99	0.41	0.62
25	~CO+~NE	0.99	0.39	0.62
26	NE+~CRP	0.97	0.40	0.61
27	NE+~CIS	0.98	0.39	0.61
28	CO+~TMS	1.00	0.36	0.61

Note: The asterisk (*) indicates the configuration has good internal consistency

As observed at the individual level, the absence of TRP (~TRP) is also necessary or almost necessary for low team performance at the team level. The absence of TRP has a 94.0% chance of producing low team performance. Furthermore, the RoN is high enough to consider the absence of TRP a necessary or almost necessary condition to produce low team performance (RoN = 0.950) and be considered non-trivial. Finally, ~TRP explains 94.0% of the variation in low team performance. See Figure 4.20 for the XY-plot of the absence of TRP configuration.

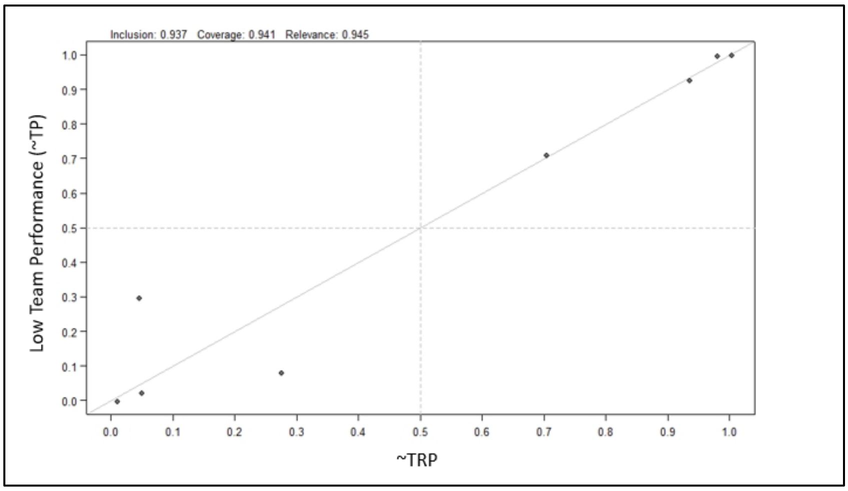

Figure 4.20. Necessity Relation of ~TRP to ~TP (n = 8 teams)

Regarding personality traits and low team performance at the team level, none of the traits appeared to produce low team performance on their own. However, the analysis revealed that the absence of all personality traits could lead to low team performance, but not in some configurations such as presence of Ex or NE (EX + NE), presence of NE or absence of CRP (NE + ~CRP), presence of NE or absence of CIS (NE + ~ CIS), and presence of conscientiousness CO or absence of TMS (CO + ~TMS). The configuration EX or NE implied that in teams where these personalities are high, there is a 96.0% chance to cause low team performance. High scores of extraversion in teams (or too many team members with high extroversion) can be detrimental to the team due to leadership struggles. High levels of NE are linked to reducing team cohesiveness, and high levels of disagreements due to ill-tempered team members can lead to low team performance. The configuration NE or ~CRP implies that if NE is high among team members, high scores of CRP are needed to avoid low team performance. Team members high on NE can manifest behaviors such as anxious, insecure, and self-pitying at the individual level (Driskell et al., 2006; Juhász, 2010; O'Neill & Allen, 2010). At the team level, high NE is characterized with reduced team cohesiveness, disagreements, and disruption of task coordination (Ghani, Yunus, & Bahry, 2016; Schippers, 2012; Juhász, 2010; Kamdar & Dyne, 2007; Neuman & Wright, 1999). It makes since to be combined with CRP because it can offset the effects of high NE when team members are dedicated to team's objectives and willingness to ensure the team does not fail (Albanese, 1994; Barry et al., 1997; Franz et al., 2016; Harper et al., 2016; Ibrahim et al., 2015; Spatz, 2000b). CIS is also important to offset high levels of NE to prevent low team performance, which was observed in the configuration NE + ~CIS. The exchange of relevant information among all team members could force that one team member who might be high on neuroticism to participate more (CheIbrahim et al., 2015; Franz et al., 2016; Harper et al., 2016; Rotimi et al., 2015). The interesting configuration here is the presence of CO or the absence of TMS (CO + ~TMS). Though CO has been shown to be a good predictor of team performance in the literature, the researcher found one instance in which high CO could cause low team performance. In this configuration there is 100% chance for low team performance to happen if TMS is low or absent from the team. The literature did support that this could happen since CO is highly linked to individual performance. According to Bradley et al. (2012), conscientiousness is the trait with facets that deal with performance at the individual level; meaning that individuals with high conscientiousness may be inflexible and closed-minded due to their needs to be very organized, careful, and disciplined. High consciousness that leads to low team performance could be linked to low job satisfaction due to low task performance or lack of organization from the rest of the team members. It could also be linked to high levels of ambitiousness and persistency, which could also lead to dissatisfaction from other team members. Thus, it makes sense why CO appeared in combination with TMS. TMS is characterized with meeting team's expectations by collaborating and cooperating, which are attributes that are built from personal bonds between team members (Goleman, 1998; Hackman, 1973; Hare, 1976; Hogg, 1992; Zelst, 1952). To further understand this implication, more case studies are needed to fully confirm the effect of high scores of CO at the team level due to the low score in relevance of necessity (36.0%).

The personality traits that have higher relevance and coverage scores for low team performance are found in the configurations: ~OP + ~TMS, ~AG + ~OP, and ~AG + ~CIS, see Table 4.25. It suggested that any low scores or the complete absence of AG and OP lead to low team performance because their relevance of necessity approximately 70%.

4.13.8 Analysis of Sufficiency

Analysis of sufficiency is conducted to determine which conditions or configurations cause high team performance. Since necessity was analyzed at the individual and team level, the analysis of sufficiency was analyzed at the team level to determine which conditions are sufficient to produce high team performance. For details on the functions used for analysis of sufficiency, please see section “Step Five: Creation of a truth table” in chapter three.

Considering the ten conditions, a total of 1,024 possible combinations were generated with their respective inclusion and proportional reduction in inconsistency (PRI) scores. PRI is a measure of fit which describes the degree to which a condition (or configuration) is as sufficient for a positive outcome (high team performance) and as sufficient for a negative outcome (low team performance). A snapshot of the truth table generated is shown in Table 4.23 (logical remainders not shown); the entire truth table can be found in appendix XVII. Logical remainders are configurations for which no outcome was determined by QCA. Logical remainders are denoted with “?” in the full printout of the truth table in appendix XVII. The result depicted in the truth table below (Table 4.26) are the only configurations that the truthTable() and minimize() functions produced. For instance, the first configuration consisted of all five team criteria and corresponded to high team performance (OUT = 1). There were no configurations in which personality traits corresponded to high team performance (consistent with the analysis of necessity) on their own. In configurations in which personality traits are present for high team performance, team criteria are present in the outcome. Configuration number1,024 has all ten conditions present that corresponded to high team performance. It can be observed that the absence of TRP (configurations 77, 67, 913, 673) leads to low team performance regardless of the presence of the other conditions (consistent with the analysis of necessity). Configuration 434 is of interest since the results have shown that presence of AG, CO, OP, TMS, and TRP corresponded to high team performance, which implies a minimal combination of personality traits and team criteria that produces high team performance.

Table 4.26. Truth Table of High Team Performance (Teams)

Confg. No.	EX	AG	CO	NE	OP	TMS	SVGC	CRP	CIS	TRP	OUT	n	incl	PRI	Cases
16	0	0	0	0	0	0	1	1	1	1	1	1	1	1	TW1RK
896	1	1	0	1	1	1	1	1	1	1	1	1	1	1	XK9DJ
1024	1	1	1	1	1	1	1	1	1	1	1	1	1	1	59HQR
434	0	1	1	0	1	1	0	0	0	1	1	1	1	1	0AQD7
77	0	0	0	1	0	0	1	1	0	0	0	1	0.452	0	5M2N7
67	0	0	0	1	0	0	0	0	1	0	0	1	0.134	0	4DH7W
913	1	1	1	0	0	1	0	0	0	0	0	1	0.083	0	9BW2Q
673	1	0	1	0	1	0	0	0	0	0	0	1	0.06	0	Q97Y2

Note: Logical remainders not shown. See appendix XVII

While the truth table displays specific configurations, this information is not in summary form, and any critical inference cannot be drawn from it. Considering the high number of configurations (1024), it would not be easy to consider each configuration individually and draw any generalizations effectively. As such, the *eQMC* function was used to generate key configurations that meet a particular inclusion threshold (0.90). Three types of solutions were obtained from the minimization process: complex, intermediate, and parsimonious. The complex solution, also known as conservative, only looks at the configurations with a positive outcome and ignores everything else as logical remainders are considered insufficient. In other words, it is looking for the most straightforward, most conservative solutions that lead to a positive outcome. The parsimonious solution is much simpler than the complex solution; it uses a less conservative approach and uses the remainders. The intermediate solution lies in between complex and parsimonious solutions and uses some of the remainders. In other words, it is the middle ground and the solution this research is searching for.

4.13.9 Complex Solution

The minimization process for the complex solution generated only one model with three prime implicants joined by the logical * AND (*) for high team performance, and one complex solution for low team performance with four prime implicants (see Table 4.27). Prime implicants are configurations made of conditions representing a route to high team performance.

M1 (High TP): EX*AG*NE*OP*TMS*SVGC*CRP*CIS*TRP +

~EX*AG*CO*~NE*OP*TMS*~SVGC*~CRP*~CIS*TRP +

~EX*~AG*~CO*~NE*~OP*~TMS*SVGC*CRP*CIS*TRP = TP

M1 (Low TP): ~EX*~AG*~CO*NE*~OP*~TMS*~SVGC*~CRP*CIS*~TRP +

EX*~AG*CO*~NE*OP*~TMS*~SVGC*~CRP*~CIS*~TRP +

EX*AG*CO*~NE*~OP*TMS*~SVGC*~CRP*~CIS*~TRP +

~EX*~AG*~CO*NE*~OP*~TMS*SVGC*CRP*~CIS*~TRP = ~TP

Table 4.27. Complex Solution for Low and High Team Performance (Teams)

No.	Prime Implicants	inclN	PRI	covS	covU	Cases
1	EX*AG*NE*OP*TMS*SVGC*CRP*CIS*TRP	1*	1	0.366	0.360*	XK9DJ; 59HQR
2	~EX*AG*CO*~NE*OP*TMS*~SVGC*~CRP*~CIS*TRP	1*	1	0.186	0.179*	0AQD7
3	~EX*~AG*~CO*~NE*~OP*~TMS*SVGC*CRP*CIS*TRP	1*	1	0.188	0.182*	TW1RK
	M1 (High TP)	**1***	**1**	**0.728**		
1	~EX*~AG*~CO*NE*~OP*~TMS*~SVGC*~CRP*CIS*~TRP	1*	1	0.189	0.178*	4DH7W
2	EX*~AG*CO*~NE*OP*~TMS*~SVGC*~CRP*~CIS*~TRP	1*	1	0.258	0.184*	Q97Y2
3	EX*AG*CO*~NE*~OP*TMS*~SVGC*~CRP*~CIS*~TRP	1*	1	0.186	0.113*	9BW2Q
4	~EX*~AG*~CO*NE*~OP*~TMS*SVGC*CRP*~CIS*~TRP	1*	1	0.181	0.166*	5M2N7
	M1 (Low TP)	**1***	**1**	**0.720**		

Note: The asterisk (*) indicates that the configuration has good internal consistency

Notably, the M1 solution consists of three prime implicants with perfect sufficiency inclusion (1.0) but only covers 72.8% of high team performance variation. Prime implicant no. 1 covers 36.0% of the cases uniquely, while no. 2 and no. 3 cover only 17.9% and 18.2%, respectively, of cases uniquely. It implies that high team performance seems to be achievable through three prime implicants based on the sampled cases (See Table 4.27). In those teams in which CO is not observed (prime implicant 1 in Table 4.27), team performance is achievable with the presence of EX, AG, NE, OP, and the presence of all five team criteria conditions. In the absence of EX, NE, SVGC, CRP, and CIS (prime implicant 2 in Table 4.27), high team performance is still achievable with the presence of AG, CO, OP, TMS, and TRP. Prime implicant three implies that if all the personality traits are missing, the presence of SVGC, CRP, CIS, and TRP, is still sufficient to produce high team performance. However, prime implicant three seems impossible since personality is always going to be present due to human nature. Finally, it can be observed that TRP must present in all prime implicants to achieve high team performance. The complex solution M1 implies that high team performance seems achievable 100% of the time by combining these three prime implicants, based on the sampled cases.

Four prime implicants explained the complex solution for low team performance with perfect sufficiency inclusion (1.0), with a combined coverage of 72.0% (Table 4.27). In teams where TRP is missing, or low scores in all prime implicants, it guarantees that low team performance could arise, thus impeding progress on a construction project. The analysis demonstrated that exhibiting high scores only in EX, AG, and CO (prime implicants 2 and 3), is not enough for teams to maintain high team performance in construction projects. Team criteria conditions, specially TRP, need to be present to achieve high team performance.

4.13.10 Parsimonious Solution

The minimization process for the parsimonious solution generated only one solution, one prime implicant, which only included the condition TRP (See Table 4.28). In both high and low team performance, the parsimonious solution showed that failing to have TRP directly affects the outcome of team performance. Table 4.28 shows that TRP has a 93.7% chance of achieving high team performance with a 94.1% coverage of the sampled cases. However, the unique coverage is zero, which implies that TRP is not unique, and it is shared among all other prime implicants. It is for this reason that TRP is part of all solutions and prime implicants. The same analogy is used when there is an absence of TRP resulting in low team performance.

Table 4.28. Parsimonious Solution for Low and High Team Performance (Teams)

No.	Prime Implicants	inclN	PRI	covS	covU	Cases

1	TRP	0.937*	0.922	0.941*	-	TW1RK; 0AQD7; XK9DJ; 59HQR
	M1 (High TP)	**0.937***	**0.922**	**0.941***		
1	~TRP	0.941*	0.932	0.937*	-	4DH7W; 5M2N7; Q97Y2; 9BW2Q
	M1 (Low TP)	**0.941***	**0.932**	**0.937***		

Note: The asterisk (*) indicates the configuration has good internal consistency

4.13.11 Intermediate Solution

The intermediate solution comprises the complete set of solutions among the complex and the parsimonious solutions. The intermediate solution consisted of analyzing the presence of the conditions that contribute to team performance. The output (low and high team performance) for the intermediate solution is detailed in Table 4.29. Similar to the complex and parsimonious solutions, the intermediate solution consisted of only one solution with two prime implicants (Table 4.29). Figure 4.21 includes the XY-plot for a graphical representation of M1 (high team performance).

M1 (High TP): SVGC*CRP*CIS*TRP + AG*CO*OP*TMS*TRP = TP

- the presence of shared values, goals, culture, and commitment and responsibility, and communication and information sharing, and trust and respect (SVGC*CRP*CIS*TRP) or
- presence of agreeableness and conscientiousness and openness and team member satisfaction and trust and respect (AG*CO*OP*TMS*TRP) equals
- high team performance (TP)

M1 (Low TP): NE*CIS*~TRP + EX*CO*OP*~TRP + NE*SVGC*CRP*~TRP + EX*AG*CO*TMS*~TRP = ~TP

- the presence of neuroticism and communication information sharing and the absence of trust and respect (NE*CIS*~TRP) or
- the presence of extraversion, and shared values, goals and culture, and commitment and responsibility, and the absence of trust and respect (EX*CO*OP*~TRP) or

- the presence of neuroticism, and communication information sharing, and commitment and responsibility, and the absence of trust/respect (NE*SVGC*CRP*~TRP) or
- the presence of extraversion and agreeableness and conscientiousness and team member satisfaction and the absence of trust and respect (EX*AG*CO*TMS*~TRP) equals
- low team performance (~TP).

Table 4.29. Intermediate Solution for Low and High Team Performance (Teams)

No.	Prime Implicants	inclN	PRI	covS	covU	Cases
1	SVGC*CRP*CIS*TRP	1.00*	1.00	0.618	0.359*	TW1RK; XK9DJ; 59HQR
2	AG*CO*OP*TMS*TRP	0.98*	0.971	0.438	0.179*	0AQD7; 59HQR
	M1 (High TP)	**0.99***	**0.99***	**0.80***		
1	NE*CIS*~TRP	0.96*	0.95	0.21	0.19*	4DH7W
2	EX*CO*OP*~TRP	1.00*	1.00	0.26	0.18*	Q97Y2
3	NE*SVGC*CRP*~TRP	0.96*	0.92	0.19	0.17*	5M2N7
4	EX*AG*CO*TMS*~TRP	1.00*	1.00	0.19	0.11*	9BW2Q
	M1 (Low TP)	**0.99***	**0.99**	**0.73**		

Note: The asterisk (*) indicates the configuration has good internal consistency

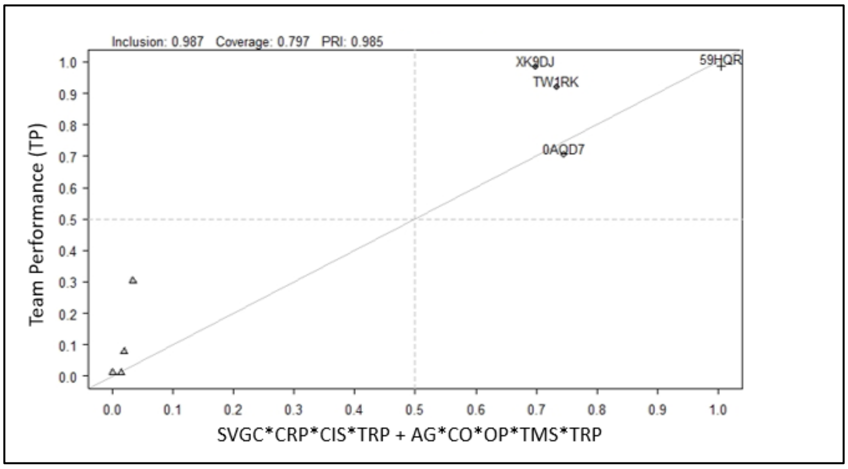

Figure 4.21. Sufficiency Relation of M1 (High TP) to TP (n = 8 teams)

The intermediate solution, M1 (high TP), is composed of two prime implicants. Each prime implicant is a conjunction, which implies that conditions must be present for high team performance to happen (first prime implicant SVGC*CRP*CIS*TRP, second prime implicant AG*CO*OP*TMS*TRP). The intermediate solution implies that each prime implicant can achieve high team performance (first prime implicant 100% chance and second prime implicant 98% chance) on its own, see Table 4.29. However, each prime implicant does not explain, or cover, all the variation in high team performance on their own. Therefore, the intermediate solution uses a disjunction “or” type combination between prime implicants (SVGC*CRP*CIS*TRP + AG*CO*OP*TMS*TRP), which implies that each prime implicant can achieve high team performance on their own but together have much larger coverage or explains 80% of the case studies (see Table 4.29). The reliability for the intermediate solution was considered reliable for this research as the inclusion score (0.99) and coverage score (0.80) are high. The intermediate solution also assisted in answering Q3 and accepting Hypotheses 1 and 2, by revealing that AG, CO, and OP are the personality traits that mostly explain or positively influence team performance in construction projects (AG*CO*OP).

The literature suggested that EX, CO, and AG are the three traits consistent with team performance prediction, however, EX was not part of the intermediate solution. Based on the sampled cases, the presence of AG, CO, and OP, combined with team criteria conditions of TMS and TRP, were the traits with a greater chance of predicting high team performance in construction project teams, thus, accepting Hypothesis 2. This research also accepted Hypothesis 1, which argued that the presence of personality traits could act as a functional equivalent to team criteria to achieve high team performance and although the unique coverage (0.179) is lower than the first prime implicant (0.359), there is evidence that personality traits could act as functional equivalence to team criteria. It is also important to mention that this solution does not demonstrate personality traits to be predictors of team performance on their own but indicates that a combination of team criteria and personality traits must be present, as it has been observed in the analysis of necessity for the individual and team levels.

To best describe the intermediate solution, the QCA package offers a factorization function, which is a sum of products. The factorization function only revealed one factor for high team performance, which is shown below:

F1: TRP*(SVGC*CRP*CIS + AG*CO*OP*TMS)

- F1 implied that the presence of trust and respect, and presence of shared values, goals, and culture; and commitmentand responsibility and communication and information sharing, leads to high team performance, or
- presence of trust and respect and agreeableness and conscientiousness and openness and team member satisfaction, and trust and respect, lead to high team performance.

The factor above agrees with Hypothesis 1 and 2 and the null hypotheses are accepted, which applies that some of the team criteria conditions and personality traits are functional equivalents to TRP and that TRP is a necessary or almost necessary condition to achieving high team performance.

The intermediate solution for low team performance showed that the absence of ~TRP in all four prime implements leads to low team performance regardless of the presence of the other conditions. The importance of TRP is seen in all types of solutions and in the analysis of necessity. Failing to have TRP among team members of a team, according to the solution, potentially guarantees that team performance could be affected negatively in construction projects. The factorization function for low team performance revealed two factors (F1 and F2), which are shown below:

F1: ~TRP*(NE*CIS + EX*CO*OP + NE*SVGC*CRP + EX*AG*CO*TMS)

F2: EX*CO*~TRP*(OP + AG*TMS) + NE*~TRP*(CIS + SVGC*CRP)

The factors for low team performance validate even further the importance of TRP in construction projects. F1 implies that the absence of ~TRP in teams, despite the rest of the conditions, could reflect low team performance during construction. F2 combines personality traits with TRP. In F2, the prime implicant EX*CO*~TRP*(OP + AG*TMS) implies that if the teams have good leaders (EX) and are organized (CO), without ~TRP, the team could still reflect low team performance despite the scores of the other conditions. The prime implicant NE*~TRP*(CIS + SVGC*CRP) implies that if team members are calm (low NE) and a peaceful team environment exists, the absence of TRP in the team could still reflect low team performance. Furthermore, the combination of the prime implicants in F2 implies low team performance.

4.13.12 Robustness of the Solution

The robustness function in the QCA package calculates the retention probability for a crisp type QCA using different perturbation scenarios. The data set for this research was calibrated to a fuzzy type. However, to test robustness, the raw data was calibrated to crisp type calibrations (values 0 = exclusion and 1 = inclusion). Before conducting the robustness test, the intermediate solution was minimized to ensure the solution was similar to the fuzzy calibrated data. The crisp calibrated data resulted in an equal truth table and equal solution for the intermediate solution. Thus, the robustness test was conducted. The robustness test used was the corruption test, which consisted of simulating changes in the conditions if the values changed between 0 and 1, or vice versa. (See Table 4.30).

Table 4.30. Robustness of the Solution (Teams)

Test	Description	Retention Probability
Corruption	Find retention probability for 2.5% probability of data corruption.	0.8166518
Corruption	Find probability that a solution could change.	0.1833482

Note: Assuming independent perturbation assumption

The robustness test for corruption implied that at 0.025 perturbation probability when corrupting cases, the retention probability is 81.67%, which means that the chance of the solutions changing is 18.33%. It means that if values in the truth table were to change from 1 to 0, 0 to 1, or be deleted, the result is the probability of retaining the solution. For this study, it means that it would take at least 7 more participants to see a change in the results (positively or negatively affecting team performance). However, depending on how the new participants complete the questionnaires, changes could be observed, or the solutions might remain the same (Dusa, 2021; Ragin, 2008). The robustness test also reiterates that a larger sample size is needed to solidify the findings in this research.

4.14 Multinomial Logistic Regression

The logistic regression model used in the current study had team performance, a categorical variable as the target, and a team criterion and personality as the predictor variables. Variables eliminated due to multicollinearity were not included in the logistic regression model as they would significantly affect the quality of results obtained. For more details see the "Secondary Analysis" in Chapter 3.

Multinomial logistic regression was conducted using JMPpro, and the coefficients output are displayed in Table 4.31. As per the regression results, none of the independent variables included in the regression model is a statistically significant predictor of high team performance. Looking at the coefficients table, there were no predictor variables that were considered marginally significant within the 95% confidence level (probabilities falling between 0.05 and 0.01).

Table 4.31. Regression Coefficients and Corresponding p-values for Logistics Regression

Term	Estimate	Std Error	Chi-Square	Chi-Sq p-value
Intercept	-55.23	3236.66	0.00	0.99
TMS	43.69	10965.51	0.00	1.00
SVGC	-94.73	11872.51	0.00	0.99
CRP	-65.23	12395.52	0.00	1.00
CIS	196.09	16206.34	0.00	0.99
TRP	192.07	13844.73	0.00	0.99
EX	9.72	5054.92	0.00	1.00
AG	48.62	7511.62	0.00	0.99
CO	15.49	8411.54	0.00	1.00
NE	-22.22	6854.83	0.00	1.00
OP	-37.49	6088.16	0.00	1.00

Since the multinominal regression did not produce viable results, the researcher used the logistic fit model to determine which of the predictor variables (conditions) relates to high team performance. The results, as shown in Table 4.32 and Figure 4.22, revealed that six of the predictor variables, TMS, SGVC, CRP, CIS, TRP, and AG, have a relationship to achieve high team performance, when present in a team. Similar results were obtained when evaluating low team performance as the absence of the same six predictor variables negatively impacts team performance. The Chi-square and odds ratio were of interest because they demonstrate if the predictor has a significant statistical effect (or likelihood) to achieve high team performance. Similar to the results of the QCA, the whole model test for logistic fit for TRP has the highest Chi-square estimate (30.25), a significant p-value (<.0001*), and an odds ratio of 222613.50. TRP's r-squared is 0.6813, which explains 68.13% of the variation. Predictors TMS, SVGC, CRP, and CIS had significant p-values (see Table 4.32). The personality traits of EX, CO, NE, and OP did not reveal any statistically significant influence. However, the AG personality trait was the only predictor that had statistical influence with a chi-square estimate of 9.52, a p-value of 0.002*, and an odd ratio of 105.23, indicating an increase in team performance as AG increases across the team. Though QCA revealed that AG, CO, and OP were the major influential traits in predicting high team performance, the logistic fit model only revealed AG to be a good predictor of team performance, revealing that at least one personality trait influences team performance.

Like the QCA, team criteria have a significant likelihood to influence high team performance. Though the multinominal logistic regression results were not viable in this research, the logistic fit model revealed evidence of influence of the predictors on team performance. Future research may include increasing the sample size as it could help the logistic regression to work better and reveal the combination of predictors that lead to high team performance.

Table 4.32. Coefficients and Corresponding p-values for Logistic Fit (Y and X)

Term	**Estimate**	**Std Error**	**Chi-Square**	**Prob>Chi-Sq**	**R2**	**Odds Ratio**
Whole Mod. Test	-	-	25.36	<.0001*	0.57	22724.47
Intercept	-2.83	1.21	5.45	0.0196*		
TMS	12.71	4.58	7.72	0.0055*		
Whole Mod. Test	-	-	25.89	<.0001*	0.58	74692.41
Intercept	-2.78	1.19	5.45	0.0196*		
SVGC	12.93	4.58	7.95	0.0048*		
Whole Mod. Test	-	-	19.83	<.0001*	0.45	13528.59
Intercept	-1.97	1.03	3.68	0.0550		
CRP	10.64	4.23	6.33	0.0118*		
Whole Mod. Test	-	-	27.36	<.0001*	0.62	17167.51

Table 4.32 Continued.

Term	Estimate	Std Error	Chi-Square	Prob>Chi-Sq	R2	Odds Ratio
Intercept	-2.96	1.25	5.58	0.0181*		
CIS	14.26	5.13	7.73	0.0054*		
Whole Mod. Test	-	-	30.25	<.0001*	0.68	222613.5
Intercept	-3.77	1.63	5.32	0.0211*		
TRP	17.34	6.78	6.54	0.0106*		
Whole Mod. Test	-	-	0.00	0.9578	0.00	1.07
Intercept	1.03	0.70	2.18	0.1401		
EX	0.07	1.24	0.00	0.9578		
Whole Mod. Test	-	-	9.52	0.0020*	0.21	105.23
Intercept	-0.76	0.71	1.14	0.2865		
AG	4.66	1.80	6.70	0.0096*		
Whole Mod. Test	-	-	0.8	0.3709	0.02	3.06
Intercept	0.55	0.67	0.68	0.4100		
CO	1.12	1.27	0.78	0.3774		
Whole Mod. Test	-	-	0.52	0.4720	0.01	2.37
Intercept	0.65	0.67	0.96	0.3283		
NE	0.91	1.28	0.51	0.4769		
Whole Mod. Test	-	-	1.17	0.2798	0.03	3.89
Intercept	0.46	0.65	0.50	0.4791		
OP	1.36	1.29	1.11	0.2915		

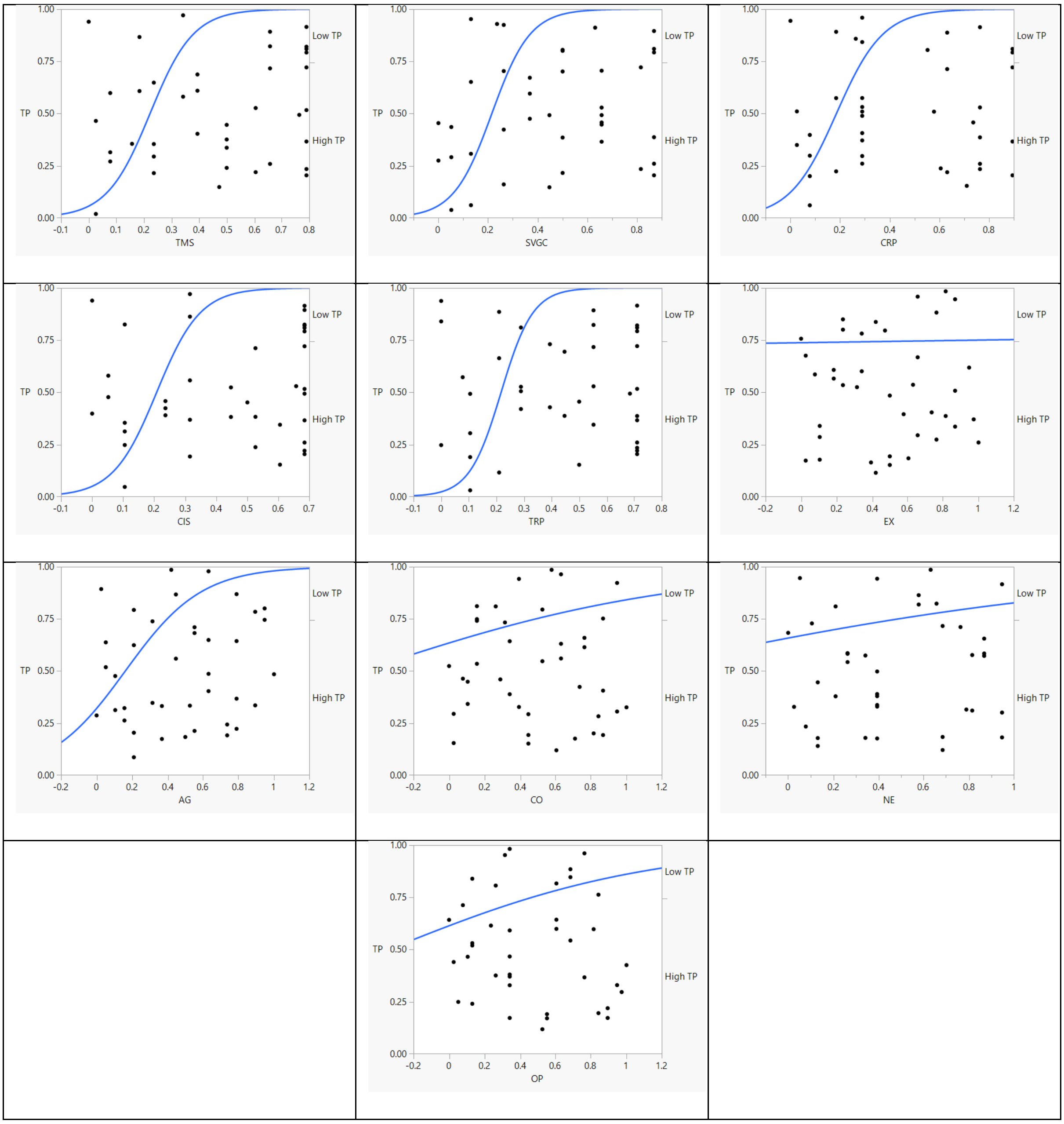

Figure 4.22. Logistic Fit TP by Predictor Variables (Conditions)

4.15 Principal Component Analysis

Principal component analysis (PCA) is a dimensionality reduction technique that reduces the number of features in a dataset. While PCA is mainly used in dimensionality reduction, it is also an effective way of creating a dataset with new orthogonal features to each other. For more details, see section “Secondary Analysis” in chapter three. PCA in the current study was conducted in JMP Pro. PCA was performed using the individual-level data since the sample size is 39, compared to team-level data with a sample of eight. First, a multivariate correlation procedure was conducted using all ten independent variables, which assisted in determining correlations or relationships between the independent variables (Table 4.33 and Figure 4.23 for the Scatter). After running the multivariate correlation procedure, the PCA was conducted on the correlations. Table 4.34 was generated showing the PCA results. A visual inspection of Table 4.31 illustrates that the first factor explains approximately 46.33% of the variance in the dataset. The cumulative variance explained by the first six factors is 93.68%.

Table 4.33. Multivariate Correlations for Personality Traits and Team Criteria

	TMS	SVGC	CRP	CIS	TRP	EX	AG	CO	NE	OP
TMS	1.0000									
SVGC	0.7874***	1.0000								
CRP	0.7320***	0.7761***	1.0000							
CIS	0.8199***	0.6904***	0.7460***	1.0000						
TRP	0.9000***	0.8370***	0.7796***	0.8242***	1.0000					
EX	-0.0324	-0.1490	-0.3369*	0.0109	-0.0929	1.0000				
AG	0.4177**	0.3782*	0.2105	0.2956	0.5005***	0.0170	1.0000			
CO	0.3219*	0.2067	0.2657	0.1487	0.3192*	0.0487	0.3145	1.0000		
NE	0.1128	0.2466	0.3099	0.1044	0.1901	-0.1355	-0.1448	0.2041	1.0000	
OP	0.2608	0.1684	0.0987	0.1864	0.2862	0.0100	0.5441**	0.3301*	-0.2470	1.0000

Note: p-values < 0.0001 = ***; p-values 0.001 = **; p-values 0.05 = *

Table 4.34. Principal Components / Factor Analysis

Number	**Eigenvalue**	**Percent**		**Cum Percent**	**Chi-Square**	**DF**	**p-value**
1	4.63	46.33		46.33	248.91	42.35	<.0001*
2	1.69	16.86		63.19	137.57	40.84	<.0001*
3	1.07	10.72		73.90	100.21	33.86	<.0001*
4	1.01	10.13		84.03	77.59	26.68	<.0001*
5	0.54	5.35		89.38	43.13	19.85	0.0018*
6	0.43	4.30		93.68	28.68	13.86	0.0108*
7	0.26	2.60		96.28	13.34	8.65	0.1301
8	0.19	1.88		98.16	6.11	4.80	0.2735
9	0.11	1.06		99.22	0.69	1.83	0.6654
10	0.08	0.78		100.00	0.00	-	-

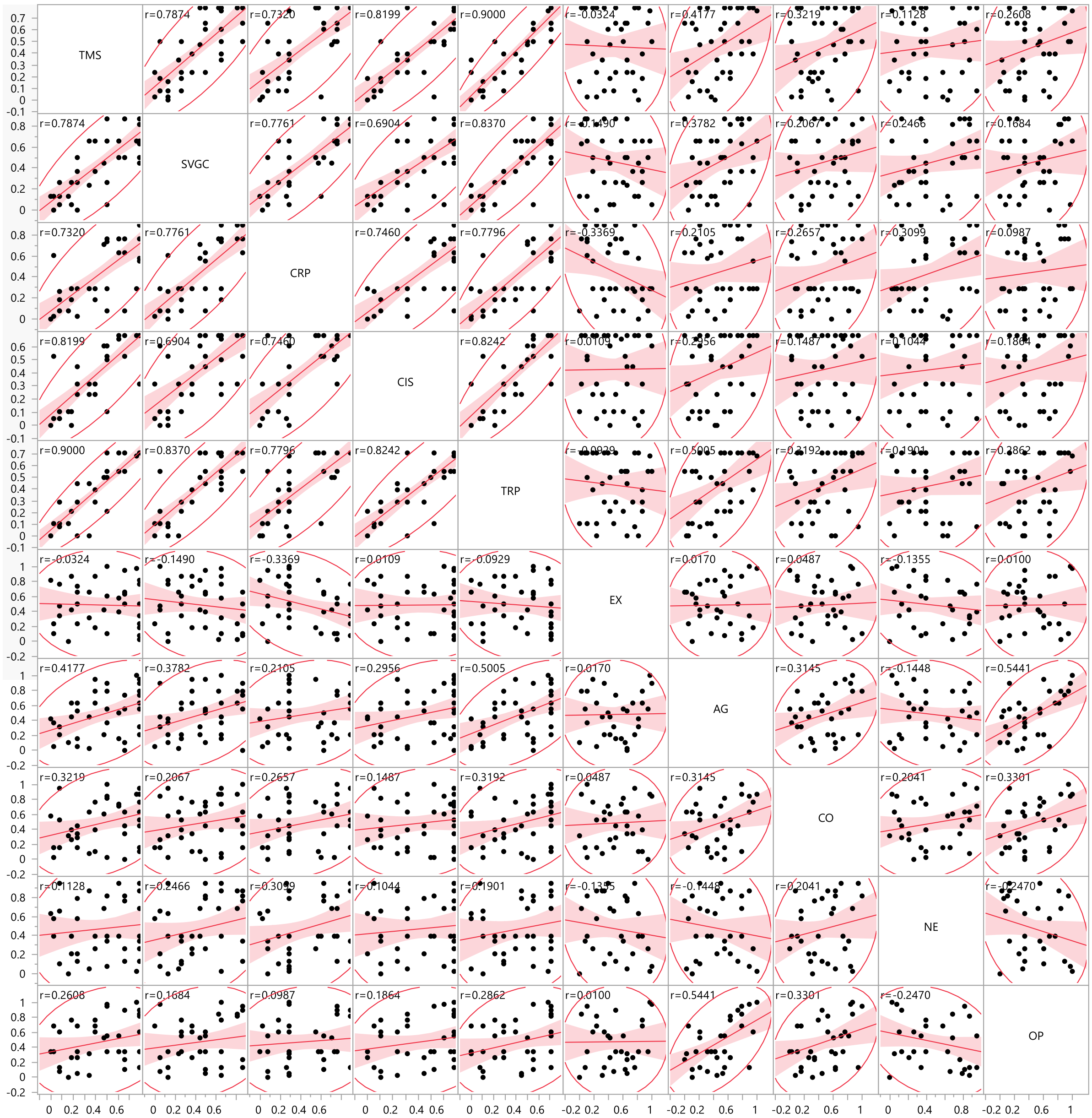

Figure 4.23. Scatterplot Matrix Personality Traits and Team Criteria

From the PCA, the eigenvalues, which represent the predictor variables, are part of the decision criteria that assisted this research in finding how many important variables explained their influence on team performance. In this research, from the ten independent variables, four had eigenvalues greater than 1.0, as shown in *First Principal Component Consisted Mostly of Team Criteria with Three Personality Traits* Table 4.31, which indicated that these variables included more information in explaining most of the variation in high team performance than just one unique variable (AG, CO, and OP) (see Table 4.32 for PCs loading). However, the highest loading scores in principal component one was concentrated mainly with team criteria (loadings from 0.85 to 0.96). TRP had the higher loading variable (0.96) and OP had the lowest loading score (0.35) principal.

Table 4.35 indicates that the variables that contributed the most to the first principal component were TMS, SVGC, CIS, and TRP, with TRP having the highest loading value of 0.959. Personality traits had a smaller loading values in the first component than the team criteria. The second principal component shows that openness to experience has the highest loading value of 0.743. NE in the second principal component had a negative influence on team performance, with loading of -0.614. The second component explained 16.861% of the variation (See Table 4.34). The third principal component consisted of CO having the strongest influence with a loading value of 0.718. The third principal component explained approximately10.72% of the variation. Finally, the fourth principal component consisted of EX having the strongest influence with loading of 0.865 and 10.13% of the variation being explained by this component. To determine which variables/conditions formed each principal component, and clear out the weak loadings in Table 4.35, a variable clustering was performed, which was an option in the JMP Pro principal component function. The clustering options results are detailed in Table 4.36 (Standardized components) below. The cluster aided to understand which variables are essential for each principal component. The researcher concluded that principal component one consisted of the five team criteria conditions (TMS, SVGC, CRP, CIS, and TRP), principal component two consisted of three personality traits (AG, CO, and OP), principal component three consisted only of NE, and component four consisted of EX.

Table 4.35. Principal Components Loadings

Conditions	**Prin1**	**Prin2**	**Prin3**	**Prin4**	**Prin5**	**Prin6**	**Prin7**	**Prin8**	**Prin9**	**Prin10**
TMS	**0.92**	0.01	-0.15	0.10	-0.09	-0.04	-0.01	-0.27	0.14	0.13
SVGC	**0.88**	-0.17	-0.09	-0.01	0.13	-0.04	**0.38**	0.03	-0.14	0.04
CRP	**0.86**	-0.34	0.02	-0.13	-0.15	0.03	0.00	0.29	0.17	0.01
CIS	**0.85**	-0.09	-0.32	0.13	-0.12	0.12	-0.29	0.06	-0.18	0.04
TRP	**0.96**	-0.01	-0.09	0.04	0.05	-0.03	-0.02	-0.11	0.02	-0.24

Table 4.35 Continued.

Conditions	Prin1	Prin2	Prin3	Prin4	Prin5	Prin6	Prin7	Prin8	Prin9	Prin10
EX	-0.15	**0.37**	-0.26	**0.87**	0.07	0.07	0.07	0.09	0.05	-0.01
AG	**0.53**	**0.62**	0.10	-0.14	**0.45**	-0.28	-0.13	0.08	0.01	0.04
CO	**0.40**	0.29	**0.72**	0.26	**-0.36**	-0.20	0.01	0.01	-0.06	0.00
NE	0.22	-0.61	**0.55**	0.27	**0.37**	0.23	-0.08	-0.04	0.01	0.02
OP	**0.35**	**0.74**	0.18	-0.23	-0.02	**0.48**	0.06	0.00	0.01	0.00

Note: Loadings > 0.30 were influential, which were bolded for clarity

Table 4.36. Standardized Components of the Variable Clusters

Variable	Cluster 1 Coefficients	Cluster 2 Coefficients	Cluster 3 Coefficients	Cluster 4 Coefficients
TMS	0.46	0	0	0
SVGC	0.44	0	0	0
CRP	0.43	0	0	0
CIS	0.44	0	0	0
TRP	0.47	0	0	0
EX	0	0	0	1
AG	0	0.61	0	0
CO	0	0.49	0	0
NE	0	0	1	0
OP	0	0.62	0	0

Then, a factor analysis was conducted on the correlations using maximum likelihood, with the results shown in Table 4.37. The goal was to identify and understand patterns between personality and team criteria and their influence on team performance. Factor loadings greater than 0.30 are of interest in this research. The reason why 0.30 loading was used is due to what was observed in the QCA results. In the QCA results, personality traits did not result as a single prime implicant, but only in combination with team criteria conditions. Since it is understood that personality traits are an essential part of a team member's behavior, and are always present, a 0.30 load was deemed sufficient as the minimum loading for this research. The underlying latent variables from the factor analysis were compared to the QCA findings, as shown in Table 4.37. The comparison demonstrates that the same variables or conditions are present in both analyses as contributors to high team performance, which were TRP, CIS, TMS, SVGC, CRP, AG, OP, CO, EX, and NE.

The results in Table 4.38 indicate that the first factor accounted for approximately 39.06% of the variation; the second factor, 14.39%; the third factor, about 8.32%; and the fourth factor, approximately 7.90%. Thus, the four factors accounted for approximately 69.66% of the total variation. The significant test analysis suggested that four factors were sufficient to explain the variation in team performance.

Table 4.37. Variance Explained by Each Factor

Factor	Variance	Percent	Cum Percent
Factor 1	3.91	39.06	39.06
Factor 2	1.44	14.39	53.45
Factor 3	0.83	8.32	61.76
Factor 4	0.79	7.90	69.66

Table 4.38. Rotated Factor Loading

Conditions/Variables	Factor 1	Factor 2	Factor 3	Factor 4
TRP	0.90	0.30	-0.04	0.17
CIS	0.89	0.07	0.07	0.00
TMS	0.89	0.25	0.05	0.14
SVGC	0.83	0.15	-0.14	0.17
CRP	0.82	-0.02	-0.32	0.25
AG	0.28	0.77	0.01	0.03
OP	0.10	0.67	0.01	0.03
EX	-0.07	0.02	0.82	-0.02
CO	0.13	0.36	0.07	0.64
NE	0.19	-0.30	-0.14	0.49

Reviewing the rotated factor loading in Table 4.38, factor 1 consisted of TRP, CIS, TMS, SVGC, and CRP with positive. Factor 1 described team criteria only. Factor 2 was composed of three personality traits, AG, OP, and CO, and one team criteria, TRP, with positive loading. Factor 2 described personality and team criteria. Factors 3 consisted of EX and CRP, with EX positive loading and CRP negative loading for team performance. Factor 3 was considered to describe personality and team criteria. Finally, factor 4 consisted of CO and NE positive loading for team performance. Factor 4 only described personality (see Figure 4.24 for Factor Analysis Score Plot).

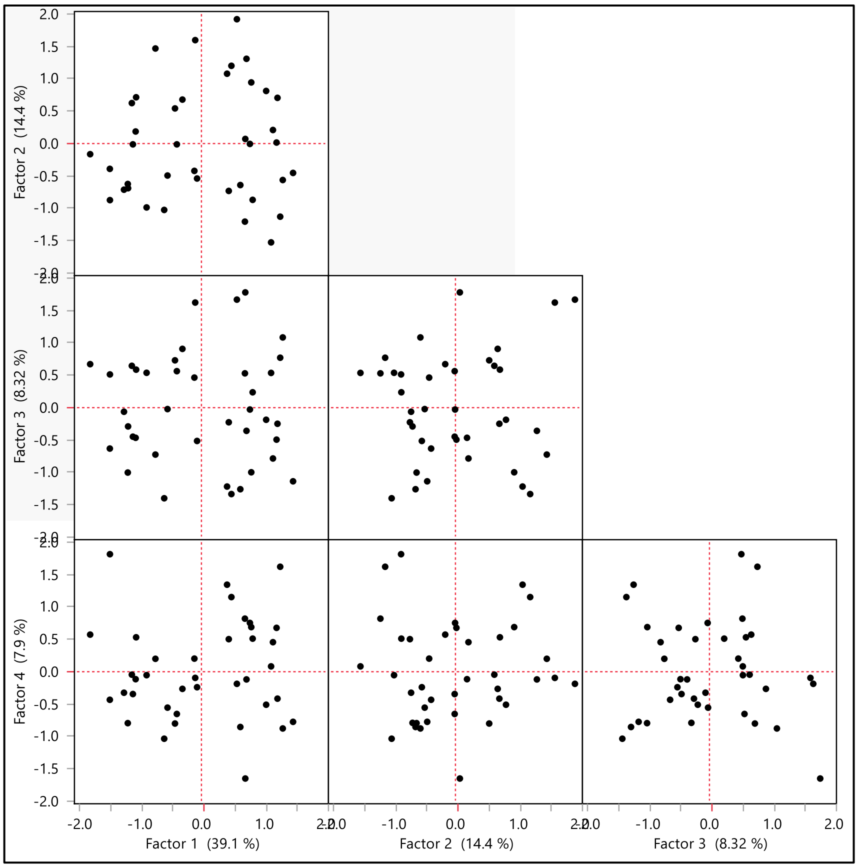

Figure 4.24. Factor Analysis Score Plot

4.16 Hierarchical Regression Analysis

Hierarchical regression was conducted to assess the impact of each of the variables on team performance. Particularly, instead of running a conventional regression model where coefficients and p-values for all variables are computed simultaneously, the analysis was done such that each variable was entered in the model, one at a time. In the first model shown in Table 4.39, only Team-Criteria-I (team criteria measured at the individual level) was entered as the predictor variable. In contrast, team performance was entered as the response variable. The model was statistically significant (F = 354.80, df = 30, p = <0.001) and had a high adjusted R-squared value of 0.92. Additionally, Team-Criteria-I was found to be a statistically significant predictor of team performance (β = 1.36, p = <0.001). For every one-unit increase in team criteria scores, team performance increases by 1.36 times according to the beta (β) estimate.

Table 4.39. Hierarchical Regression Analysis Block One

(Intercept)	Estimate	Std. Error	t value	t p-value
	-0.19	0.04	-4.59	<0.001
Team-Criteria-I (β)	1.36	0.07	18.84	<0.001
Overall Model Significance F-Statistics: 354.80 on 1 and 30 df, p-value: < 0.001, Adjusted R-squared: 0.92				

In the second regression model shown in Table 4.40, one more independent variable, Team-Criteria-T (Team criteria measured at the team level) was added to the first regression model. The model was statistically significant (F = 172.30, df = 29, p = 0.001). The R-squared value for the second model was 0.92, indicating that the two independent variables explained 92.0% of all variation in team performance. However, only Team-Criteria-I was found to be a statistically significant predictor of team performance (β = 1.35, p = <.001). Team-Criteria-T was not a statistically significant predictor of team performance (β = 0.02, p = .73).

Table 4.40. Hierarchical Regression Analysis Block Two

(Intercept)	Estimate	Std. Error	t value	t p-value
	-0.19	0.05	-4.28	<0.001
Team-Criteria-I (β)	1.35	0.07	18.03	<0.001
Team-Criteria-T (β)	0.02	0.05	0.35	0.73
Overall Model Significance - F-Statistics: 172.30 on 2 and 29 df, p-value: < 0.001, Adjusted R-squared: 0.92				

In the third regression model, one more predictor, Personality-I (personality traits at the individual level), was added to the previous model, making a total of three predictor variables. From Table 4.41, the model was statistically significant (F = 112.5, df = 28, p = <.001). Additionally, the model's adjusted R-squared value for the third regression model was 0.92, indicating that the model explained 92.0% of variation in team performance. Still yet, only Team-Criteria-I was found to be a statistically significant predictor of team performance (β = 1.35, p = .001) while Team-Criteria-T (β = 0.02, p = .78) and Individual Personality (β = 0.06, p = .55) were non-significant predictors.

Table 4.41. Hierarchical Regression Analysis Block Three

(Intercept)	Estimate	Std. Error	t value	t p-value
	-0.22	0.06	-3.56	0.001
Team-Criteria-I (β)	1.35	0.08	17.75	<0.001
Team-Criteria-T (β)	0.02	0.05	0.28	0.78
Personality Individual (β)	0.06	0.09	0.61	0.55
Overall Model Significance - F-Statistics: 112.50 on 3 and 28 df, p-value: < 0.001, Adjusted R-squared: 0.92				

Lastly, Personality-T (personality traits at the team level) was added to the model to determine its relative impact on model performance. The model results shown in Table 4.42 reveal that the model is statistically significant (F = 82.70, df = 27, p = <.001). The adjusted R-squared for the fourth model is 0.91, indicating that the model explained 91.0% of all variation in team performance. The additional variable, Team Personality, was a non-significant predictor of team performance. Therefore, from the four regression models, team criteria at the individual level was the only factor that impacts team performance.

Table 4.42. Hierarchical Regression Analysis Block Four

(Intercept)	**Estimate**	**Std. Error**	**t value**	**t p-value**
	-0.24	0.07	-3.40	0.002
Team-Criteria-I (β)	1.34	0.08	17.49	<0.001
Team-Criteria-T (β)	0.02	0.06	0.39	0.70
Personality-I (β)	0.04	0.10	0.45	0.65
Personality-T (β)	0.01	0.02	0.64	0.52
Overall Model Significance F-Statistics: 82.70 on 4 and 27 df, p-value: < 0.001, Adjusted R-squared: 0.91				

4.17 QCA Summary of the Findings

The QCA result revealed that no single personality trait is necessary or sufficient enough for explaining high or low team performance in construction projects. It was determined that team performance is related to various configurations between personality traits and team criteria that are sufficient and necessary to achieve high or low team performance. The solution of importance in this research was the intermediate solution. Parsimonious solution is the simplest solution, which could be a single condition (or combination of conditions), that is sufficient to influence team performance. The complex solution usually involves very complex combinations and can be hard to understand. Thus, the intermediate solution offers a middle ground in which the parameters of inclusion and coverages are still high to produce team performance (Ragin, 2008).

The parsimonious solution in this research for high team performance is the presence of TRP, which has a 93.7% chance of achieving high team performance and covering 94.1% of the cases. The importance of TRP is also observed in the analysis of necessity as a single condition necessary or almost necessary for high team performance. This implies that TRP, on its own or in combination with other conditions, must exist in construction teams to achieve high team performance. The case studies in which high team performance was observed, TRP was present and was absent in those with low team performance, which indicated a strong influence of TRP on team performance. The interviews provided valuable information regarding TRP by confirming that TRP was indeed present in case studies with high team performance (TW1RK, XK9DJ, 59HQR, and 0AQD7). The same was observed in the parsimonious solution for low team performance. The absence of TRP has a 94.1% chance to negatively impact team performance, as seen the case studies 4DH7W, 5M2N7, Q97Y2, and 9BW2Q, which was confirmed in the 4DH7W interviews.

The intermediate solution presents the models that contain conditions that are sufficient to influence team performance based on the parsimonious solution, which is TRP for this research. The most important conditions in this study that were sufficient to influence team performance are given below:

- TRP, TMS, CIS, SVGC, and CRP. High team performance was observed when trust and respect, team member satisfaction, communication and information sharing, sharing of values, goals, and culture, and commitment and responsibility were present in a project team.
- Low team performance was observed when trust and respect, team member satisfaction, commitment and responsibility, communication and information sharing, and sharing of values, goals, and culture were absent from a project team.
    - ~TRP, ~TMS, ~CRP, ~CIS, and ~SVGC, and ~CRP.
- High team performance was observed when shared values, goals, and culture; commitment and responsibility; communication and information sharing; and trust and respect, were present in a project team, and when agreeableness, conscientiousness,

openness, team member satisfaction, and trust and respect, were present in a project team.

    - SVGC*CRP*CIS*TRP and AG*CO*OP*TMS*TRP.

- Low team performance was observed when neuroticism, communication and information sharing, extraversion, conscientiousness, and openness were present, along with the absence of trust and respect in a project team; and when neuroticism; shared values, goals, and culture; and commitment and responsibility are present; and trust and respect wre absent in a project team; and when extraversion, agreeableness, conscientiousness, and team member satisfaction were present, and trust and respect were absent in a project team.
    - NE*CIS*~TRP, EX*CO*OP*~TRP, NE*SVGC*CRP*~TRP, and EX*AG*CO*TMS*~TRP.

Conditions present for achieving high team performance were found in cases studies TW1RK, XK9DJ, 0AQD7, and 59HQR. Conditions present for achieving low team performance were found in case studies 4DH7W, Q97Y2, 5M2N7, and 9BW2Q. Face validity and accuracy were further explained in this chapter, in the Qualitative and Quantitative Comparison section.

This research fully answered Q3 by demonstrating that three most influential personality traits in construction projects were AG, CO, and OP. Though it was different from the literature, the results from the QCA and the factorization of the principal components were able to provide enough evidence that AG, CO, and OP are the most influential personality traits on team performance. It was also confirmed that AG, CO, and OP have a positive correlation with team criteria, which had a much deeper impact on predicting team performance. Furthermore, the absence of EX and NE gives a better chance to the teams to achieve high team performance. In the analysis for necessity, all personality traits were involved either with their presence or absence that produces an outcome. Although the relevance scores were above a medium effect, their chances of appearing in the outcome is high and cannot be ignored as the associated risk of failure was low. The personality traits that had the most influence, relevance to necessity, and coverage as being necessary or almost necessary were AG and OP to experiences. In the analysis of sufficiency, AG, CO, and OP to experiences were the only personality traits that were sufficient to achieve high team performance in combination with TMS and TRP. Though CO was not found to be a necessary condition for high team performance, it was found to be sufficient. A reason why CO appeared as a sufficient condition for high team performance could be related to cases 59HQR and 0AQD. In these case studies, CO had a high score at the team level due to several team members scoring high on CO. The prime implicant number 2 in Table 4.29 (configuration) that includes the presence of AG, CO, OP, TMS, and TRP (AG*CO*OP*TMS*TRP), included CO and case studies 59HQR and 0AQD were essential contributors to prime implicant number 2. Though the coverage was not perfect in prime implicant number 2, this configuration with the three personality traits can be considered a successful path for high team performance, because it consistently leads to high team performance and explains two of the eight case studies. Furthermore, the intermediate solution demonstrated that the strongest influential was prime implicant number 1 in Table 4.29, which consisted of the combination of team criteria conditions, which is sharing values, goals, and culture, commitment and responsibility, communication and information sharing, and trust and respect (SVGC*CRP*CIS*TRP). The combination of prime implicants 1 and 2 gave a much bigger coverage, covering four of the eight case studies. Based on the QCA findings and the factorization of the principal components, this research suggests that AG, CO, and OP to experience are the most influential personality traits in construction projects that can impact team performance when they are combined with team criteria.

In both the analysis of necessity and sufficiency, TRP was the only condition that made the difference between low and high team performance. For low team performance the absence of TRP had a relevance of necessity of 94.5% covering 94.1% of the case studies. For high team performance, the presence of TRP had a relevance of necessity of 94.0% covering 93.7% of the case studies. The importance of TRP were more obvious in the analysis of sufficiency. Starting with the parsimonious solution, TRP was the only condition in the parsimonious solution that had both a negative and positive effect on team performance. The intermediate solution presented showed that TRP must be present in both prime implicants to achieve high team performance and its absence potentially leads to low team performance. Finally, the factorization of the intermediate solution revealed that TRP and SVGC and CRP and CIS or AG and CO and OP and TMS (TRP*(SVGC*CRP*CIS + AG*CO*OP*TMS) guarantees high team performance in construction projects.

4.18 Qualitative and Quantitative Comparison

Qualitative data consisted of interviews with team members related to the team performance questionnaire. The primary purpose of the interviews was to collect perspectives from team members to validate the results from the quantitative analysis, which consisted of the QCA, principal component analysis, and hierarchical regression analysis, performed on the data collected from the personality and team performance questionnaires. Initially, the interviews were to be conducted on-site to observe team members before interviews. However, due to the COVID-19 pandemic, physical access to the project sites was limited to essential personnel. Thus, the interviews were conducted via conference call and later transcribed by the researcher. Following are the interviews conducted during the data collection stage. This section will start by accessing high team performance, then average team performance, and finally, low team performance. Table 4.43 below contains the case studies' team performance scores from the team performance questionnaire (rated by team members) and the QCA results regarding team performance.

Table 4.43. Team Performance Results from TPQ and QCA

Source	**TW1RK**	**XK9DJ**	**59HQR**	**0AQD7**	**5M2N7**	**4DH7W**	**9BW2Q**	**Q97Y2**
TPQ	High TP	High TP	High TP	Avg. TP	Avg. TP	Avg. TP	Low TP	Low TP
QCA	High TP	High TP	High TP	High TP	Low TP	Low TP	Low TP	Low TP

Note: TP = Team performance

4.19 Case Studies with High Team Performance

The QCA results revealed that TRP is the essential condition that can achieve high team performance when present or achieve low team performance when absent in construction project teams. There were three cases (TW1RK, XK9DJ, and 59HQR) in which the TPQ and QCA coincided with high team performance. The only different case study was 0AQD7 which had a high average score of 0.57 from the TPQ. The QCA results placed 0AQD7 as a team with high team performance. Reviewing the truth table used for the analysis of sufficiency, TRP was always present in the case studies with high team performance.

In case TW1RK, the truth table showed the absence of all five personality traits and the presence of all team criteria conditions except TMS, and that team performance was achievable. The interview conducted in case study TW1RK revealed that TRP does exist between team members especially with the GC's field personnel. Though some mistrust existed between the PE and the GC's Project Manager (GC), over all, the team trusted each other. The PE mentioned that there was a little bit of mistrust towards the inspectors due to their low experience in construction. This may be the case since the mean for years of experience for the LaDOTD was 8.61, compared to 16.22 for the GC. Overall, the team members in this project maintained moderate levels of trust. Other important comments made by the interviewee that supported high team performance were: 1) team members enjoyed working together, 2) trust and team satisfaction was re-enforced by the understanding team members' responsibilities of other team members, and 3) respecting the work each team member performs. Also, The PE mentioned the GC does not fight issues to their advantage but works with the LaDOTD as a team to resolve them. This gives a strong sense of cohesiveness between team members. These comments are consistent with CRP, TRP, and SVGC, which were part of the intermediate solution of QCA. The interview confirmed the average TRP scores measured with the TPQ at the team level and QCA results, which indicates that the presence of TRP is a predictor for high team performance.

In case XK9DJ, the truth table showed the presence of all personality traits (EX, AG, NE, OP) but CO, and the presence of all team criteria conditions, which achieved high team performance. Case XK9DJ was another case in which trust was very strong between the LaDOTD personnel and the contractor's field personnel. In this case, the GC's Project Manager (PM) participated in an interview. The PM confirmed what the PE and some inspector had mentioned that there are trust issues between the PME and PE. However, both sides confirmed that onsite, all team members get along well and trust each other. The PM mentioned that some of the friction between the PM and PE is because the PE thought working with LaDOTD was hard,. Reviewing the GC's PM and LaDOTD's PE personality scores, it revealed that both PM and PE are high on EX. This indicates that there could be some leadership struggles that may cause tension between them. The personality score also revealed that the PE has a higher CO score than the PM. This also indicates that the PE is organized and disciplined than the PM who tends to be disorganized and counterproductive. Overall, the interviews were consistent with the QCA results and the measuring tools. The team members had high communication, and enjoyed working together because there was support among the team, and team members shared information, specially to the inspector, who only had one year of experience on the site. The comments from the interviews are consistent with TMS, CIS, and TRP. In regard to personality, case study XK9DJ was consistent with AG. The interview revealed that some of the GC's team members helped the inspector to learn about construction by being helpful, soft-hearted, trusting, concerned for team success, flexible towards a new inspector, and providing the inspector with the help needed to adjust to the project. OP was also confirmed with the interview because the GC's field personnel approached conflict with collaboration, and adaptation towards the new inspector on the project.

In case 59HQR, the truth table revealed that all five personality traits and all five team criteria conditions were present for high team performance. Though all personality traits were present in this case study, based on the personality scores, the high scores were concentrated onAG, CO, and OP. Team criteria scores were high on all five conditions (TMS, SVGC, CRP, CIS, and TRP). According to the interviews, moderate trust (consistent with TRP) exists in this project, which was acquired through good work performance, quality of work, high communication with GC's field personnel such as the superintendent, and honoring contractual obligations. According to QCA, TRP is the most influential condition for team performance. In this case study, TRP was built through work performance and quality of work, which is consistent with CRP and TMS. In return, it was also consistent with AG because of how team members trusted each other and communicated. It was consistent with CO because team members completed their tasks and honored contractual obligations. It was consistent with OP because one interesting note from the interviews was that the GC often changed their PMs. This created some friction with the LaDOTD because they had to adjust to a new PM often. The PE commented that it takes time to build relationships, especially trust, and trust can not be built if a new PM comes and goes for one project. Most of the trust that existed in this project was due to the superintendent. For this reason, the PE and inspector said that moderate trust exists. Though it was moderate, the interviews were consistent with the QCA results.

In case 0AQD7, the truth table revealed that AG, CO, and OP were the only personality traits present. For team criteria, the conditions present were TMS andTRP. According to the interviews, this project has high levels of trust between team members, which is consistent with the TRP and AG observed in the QCA results. The PE mentioned that team members enjoy working with each other because the GC representatives are good with their work, complete projects on time, and are knowledgeable in construction. This is consistent with TMS and CO, which was observed in the QCA results. Furthermore, TRP was achieved through work performance, quality of work, and high communication between team members, which is also consistent with CO. This case study lined up with prime implicant number 2 in Table 4.29. The interview in this case study did confirm the findings from the QCA.

During the interviews, it was observed that aspects of TRP between the team members was not necessarily linked to the total years of their previous relationship. However, TRP seemed to be linked more to completing tasks, responsibility, honoring contractual obligations, high work performance, quality of work, communication/interactions, finishing projects effectively, keeping promises, cooperation, and supporting each other. These type of team interactions are more linked to team criteria such as TMS, CRP, CIS, and SVGC. TMs aligns well with team interactions (such as: completing work, honoring promises, good quality of work, flexibility when issues arise, and high communication) in which TRP was built on. The more team members that are satisfied with each other, the quicker trust and respect can be established and built.

The QCA results corroborated with the interviews in both the analysis of necessity and sufficiency. The QCA revealed that all team criteria conditions are sufficient for achieving high team performance and that their absence can lead to low team performance, especially with TRP. The personality traits that were present with average or high scores at the team level were AG and CO in cases 0AQD7 and 59HQR; EX, AG, and OP in case XK9DJ; and NE in case TW1RK. It was surprising to see high NE in a project that scored high on team performance at the team level. Case TW1RK had low scores in all personality traits but NE. However, the team scored higher in this project because it had good scores for the team criteria conditions.

Furthermore, the literature revealed that in certain situations high NE can be a good thing for a team. According to an example Juhász (2010) provided, the communication of the team member with high impulsiveness can be surer (hardly any doubts) which seems to assist when dealing with issues under stress (Juhász, 2010). However, this cannot be confirmed in this research since there are not enough samples presenting the same situation except this one case.

4.20 Case Studies with Low Team Performance

In case studies with a low team performance (5M2N7, 4DH7W, 9BW2Q, and Q97Y2), TRP was absent from the truth table. This implies that team members rated low in TRP in these case studies. Case study 5M2N7 only had NE and SVGC present ,which was not enough achieve high team performance. Case study 4DH7W only had NE and CIS present, which also led to low team performance. According to the interview in case study 4DH7W, team members have had approximately 20 years of previous relationship and still do not trust each other that well. The PE mentioned keeping trust moderate or below prevents the GC from asking for any favorites throughout the construction phase. Opposite to what was observed during the interviews in case studies with high team performance, 4DH7W has not built a relationship with GC's field personnel as deep as the others due to frequent change in work force by the GC. There is only one aspect that keeps team members satisfied in this project, and that is everyone does their part and nothing more. The LaDOTD personnel in this project preferred to keep all team members on a business type relationship, and avoid any interactions that might lead to a more personal relationship. One comment from the interviewee was that "too much friendliness impacts team performance negatively due to team members ignoring some of their job obligations". Though tasks are completed, and each team member kept their contractual obligations, it was apparent that communication and collaboration could be causing some issues in this project. The PE mentioned that the GC's PM gets upset very easily. This behavior restricts communication between team members because they could be avoiding each other.

Thought the PM in this project did not volunteer for an interview, the PM did complete the TPQ and SFPQ. The PM's personality traits scores were high EX, average AG, low CO, low NE, and average OP. The PE's scores were average EX, low AG, average CO, average NE, and average OP. The inspector's scores were low on Ex, high on AG, high on CO, high on NE, and high an OP. It is apparent from these scores that their personalities clashed on this project. The GC's PM is high in EX, which could be an indication that the PM likes to lead and take control of the project. However, the high and average levels of CO could be the reason why the PE and the inspector like to keep the GC under control. Another potential reason why there is low level of trust between the project team is because the PE had low levels of AG, which is related to trust. Also, both the PE and the inspector have medium and high levels of NE respectively, which brings in distress, hostilities, irritableness, nervousness when issues or changes occur, and tend to blame other team members for mistakes (Driskell et al., 2006). These types of traits can affect the confidence of the rest of the team members. Based on the interview form 4DH7W, the researcher concluded that the QCA results for low team performance in consistent with the interviews, which reflected that the absence of TPR and personality traits such as AG, CO, and OP could create tension between team members due to lack of flexibility, trust, and enthusiasm towards knowing other team members better.

The interviews conducted in this research provided face validity of the results for high team performance. Though more interviews were needed from the case studies in which low team performance was observed, the researcher provided face validity of the findings from the interviews conducted in case study 4DH7W. The interviews also assisted in answering Q4 , for which the researcher concluded that the measuring tools (questionnaires) and the analysis procedures are accurate to measure team performance in construction projects.

4.21 Accuracy of the Findings

The objective of Q4 was to demonstrate that team performance accessment is possible by utilizing personality traits and team criteria. The robustness test in QCA was one indicator that revealed a level of accuracy of the solutions, which revealed that the retention of probability, when corrupting case studies, is 81.67%. This result implies that the chance of changing the solution is only 18.33%, which is a small value despite the sample size. For this study, it means that it would take at least 7 more participants to see a change in the results (positively or negatively affecting team performance). With a much larger sample size, it would take more participants to change the case studies' results. For example, if the research would have consisted of 20 case studies with 80 participants, with the same results, it would have taken 15 participants to change the solutions if scores were different. Thus, it is important to conduct more cases studies with this method to see if the solutions change.

Research question four in this research was answered. The interviews confirmed the importance of TRP and that the rest of the team criteria conditions have more influence, not only on team performance, but also to help to increase trust and respect among team members. This was further confirmed with the logistic fit model and the principal component analysis. The logistic fit model demonstrated that AG was the only predictor for personality traits that had statistical influence, indicating that as AG increases, the team performance increases. Although CO was not significant in the logistic fit model, the multivariate correlation revealed that CO also has a significant positive correlation with TRP. As the interviews revealed that the rest of the team criteria conditions were just as important, the multivariate correlation demonstrated that the team criteria conditions were significantly correlated between each other.

The PCA demonstrated, based on the correlation of the conditions, that the first four PCAs were statistically significant and explained 84.03% of the case studies when combined. The variables that contributed the most to the first principal component were TMS, SVGC, CIS, and TRP. A factor analysis was conducted on the principal components. The factor analysis also confirmed what was found in the QCA and the interviews. It revealed that the first factor was composed of team criteria conditions including TRP. The second factor was composed of TRP along with the personality traits of AG, OP, and CO. Factor 3 was composed of EX and CRP with positive loadings, but CRP had a negative loading factor. CRP in the factorization regression of the principal components had a positive loading in factors 2 and 4 (see Table 4.38). The QCA results in the intermediate solution the presence of CO positively affects team performance, and its absence causes low team performance. The last factor was composed of only personality traits CO and NE. From the factor analysis of the principal components, it can be implied that similar results were found between QCA and the interviews, except for CRP in factor 3.

Finally, a hierarchical regression was conducted to assess the impact of each of the variables on team performance. The hierarchical regression analysis concluded that only team criteria at the individual level was a statistically significant predictor of team performance. According to the hierarchical regression, team criteria and personality traits at the team levels were not predictors of team performance. The results were similar to the QCA of necessity, in which team criteria are shown to be predictors of team performance, especially TRP. However, it is inconclusive when it comes to the team level comparison between QCA and hierarchical regression, which could be due to the sample size since regression analyses are susceptible to small sample sizes.

4.22 Chapter 4 Summary

The main objective of Chapter four was to conduct the analysis procedures discussed in this chapter to answer research questions three and four (Q3 and Q4). The data was collected from real construction projects using two questionnaires. The personality questionnaire collected personality trait levels among construction team members, and the team performance questionnaire collected data from team member's rated opinions about team performance in their current project. The questionnaires were scored based on team members' relative measures that suggest that a team member is within a percentage of the sampled population. The relative measure scores (percentiles) were used to conduct the QCA, logistic fit model, principal component, and hierarchal regression analysis. The internal consistency of the personality questionnaire resulted in good alpha scores, as expected. However, the team performance questionnaire had two variables with low alphas that resulted in their removal (Team Composition and Team Information Sharing).

Q3 - What personality traits influence team performance in construction projects?

Question three used the data collected from actual construction projects to determine if the same personality traits found in the literature influence team performance in construction project typesetting. Access to construction projects was obtained first to distribute the personality and team performance questionnaires. The questionnaires collected the necessary data needed to conduct QCA, principal component analysis, and factorization of the principal analysis. The same questionnaires were distributed twice to the same team members to validate the team members' responses and internal consistency. QCA assisted to determined which personality traits and team criteria conditions were necessary and sufficient to produce a positive or negative outcome (team performance). Necessary consistency and relevance to necessity estimates should reveal which personality traits and team criteria must be present for high team performance. Sufficiency consistency and coverage estimates should indicate which condition(s) or the conditions' combination is sufficient for high team performance. The sufficiency analysis, intermediate solution, should also show which condition(s) should always be present and which combination explains the variability of the solutions that cover the majority of the case studies that produce high team performance. Based on the QCA, at the team level, the necessary condition for construction teams to achieve high team performance was trust and respect (see Table 4.23). It also revealed that team member satisfaction, shared values/goals/culture, commitment/responsibility, and communication/information sharing were also crucial in influencing team performance. The analysis of necessity for low team performance also confirmed that the absence of trust and respect among construction teams harms team performance. The analysis of necessity did not reveal personality traits as necessary conditions, but their presence is noticeable in some of the configurations with team criteria (see Table 4.23). The intermediate solution showed that all team criteria conditions are sufficient to achieve high team performance. Trust/respect must be part of the solution for high team performance (see Table 4.29 in the Intermediate Solution section). The intermediate solution also revealed the most influential personality traits in construction projects were: agreeableness, conscientiousness, and openness to experience (see Table 4.29). The intermediate solution successfully answered research question three by revealing that agreeableness, conscientiousness, and openness to experience are the personality traits that primarily explain or positively influence team performance in construction projects (AG*CO*OP). The QCA results were further confirmed with the principal component analysis and factorization of the principal components, revealing that all five team criteria conditions strongly affected high team performance. It also revealed that agreeableness, conscientiousness, and openness to experience are the most influential personality traits for positive team performance (see Tables 4.35 and 4.38).

Furthermore, the interviews conducted supported the QCA findings, which provided valuable information how trust influences team performance and how it was achieved. The interviews revealed that trust between member was achieved by honoring promises, completing tasks, communicating, and supporting team members when issues arise. The interviews revealed that in low team performance projects, trust was not strong among the team members.

Q4 - How accurately can personality traits and team criteria influence team performance in construction projects?

With the interview questions and the supplemental analysis procedures, it was concluded that the QCA results were accurate, and the results can be reproduced with other analysis procedures, such as the logistic fit model, the principal component analysis, and the factorization of the principal components. The interviews confirmed and provided face validity of the QCA findings and strengthen the importance of trust/respect in construction projects. It also reinforces the influence of team criteria on team performance and how each team criteria condition is correlated with the personality traits and each other to achieve positive team performance. The QCA findings' accuracy was further confirmed with the logistic fit model, the principal component analysis, and factorization of the principal components.

CHAPTER 5. DISCUSSION OF THE RESULTS

5.1 Introduction

In general, the construction industry involves activities associated with the initial delivery and subsequent maintenance of buildings, structures, industrial facilities, and different infrastructure systems. In existing research, scholars have explored and investigated the various issues that affect the success of construction projects. However, the one primary gap in the literature this research aimed to address was the absence of scholarly research on how personality traits and differences among people influence the performance of project teams. This study used a preexisting personality questionnaire (Goldberg's 50-item personality questionnaire) and a team performance questionnaire (adapted from several studies investigating team performance) to collect the necessary data for analysis. Ideally, a specific personality questionnaire should be developed, but the development itself would take years and enormous sample size to validate the personality questionnaire. Thus, this research used Goldberg's 50-item personality questionnaire because it had been validated and used in many studies investigating personality influence on team performance, such as Guchait et al. (2014), Schippers (2014), Bradley et al. (2012), Tasa, Sears, & Schat (2010), Mohammed & Angell (2003). The team performance questionnaire was adapted from several investigations that employed different team criteria to measure team performance. An evaluation was completed, and the top five team criteria and their questionnaire items (such as Franz et al. (2016), Harper et al. (2016), Rotimi et al. (2015), Ibrahim et al. (2015), Korkmaz et al. (2012), Kumaraswamy et al. (2005), (Spatz, 2000), Goleman (1998), Barry et al. (1997), Albanese (1994), Hackman (1990), Hare (1976), Zelst (1952), and Salas et al. (2005)) were adopted in this study. This research successfully employed and distributed both questionnaires to answer the research questions. Project teams are constituted by different team members, who may significantly differ in various aspects, including personality traits. Stakeholder representatives (team members) perform a crucial role in the construction industry and have an essential impact on team performance. Therefore, the primary purpose of this research was to explore the impact of personality differences in project team members on project team performance. First, a meta-analysis was conducted to determine if any findings on the impact of personality and team criteria on project team performance have been documented in prior research. Second, a primary empirical investigation was conducted to determine the effects of personality and team criteria on project team performance. In the previous chapter, the researcher presented the results of the quantitative analysis and qualitative comparative analysis (QCA). In this chapter, the researcher will discuss the findings obtained and how they will contribute to the practice of construction project teams and knowledge regarding the impact of personality and team criteria on project team's performance. In particular, the sections in this chapter include a discussion of the findings considering past literature on construction project teams' performance, practical and scholarly implications of the findings, limitations of the study, and recommendations for future research and practice. The contributions of this research to the body of knowledge are as follows: 1) the results revealed that when two single conditions, trust/respect, and commitment/responsibility, are present, team performance is high. Trust/respect was found to be the primary condition that impacts high and low team performance. 2) This study successfully explored and integrated the concepts of personality traits from social sciences and investigated their influence on team performance for real construction projects and project teams. 3) The initial process of a systematic accessment framework that can be used to access current or continue to explore construction team performance based on the presence or absence of the big five personality traits and team criteria conditions, which was a gap in the research on team performance in the construction industry.

5.2 Research Questions

- Q1: Which personality traits can influence team performance?

  According to the meta-analysis, from most influential to least based on the existing literature at the team level, the most influential personality traits were arranged as follows conscientiousness, agreeableness, extraversion, openness to experience, and neuroticism (see Table 2.10 and chapter two for more details).

- Q2: How do personality traits influence team performance?

  The review of the selected studies, meta-analysis, revealed that team members' interactions and their personalities impact team performance, either positive or negative. The review of the selected studies gave a clear understanding of the impact personality traits have on team performance and how they can be used in conjunction with team criteria. The clear understanding revealed from the selected case studies is detailed in Table 1.1 in chapter one for individuals and Table 3.5 for team-level construct, a spectrum (low = 1 to high = 5) of how personality traits influence team performance. For more details, see chapter two.

- Q3: What personality traits influence team performance in construction projects?

  The intermediate solution also revealed the most influential personality traits in construction projects were: agreeableness, conscientiousness, and openness to experience (see Table 4.29). For more details, see chapter four.

- Q4: How accurately can personality traits and team criteria influence team performance in construction projects?

  The interview questions and the supplemental analysis procedures (logistic fit model, the principal component analysis, and factorization of the principal components) assisted in concluding that QCA findings were reliable and reproducible. For more details, see chapter four starting in section 4.14 – Multinomial Logistic Regression and section 4.21 – Accuracy of the Findings.

5.3 Discussion

In the context of this study, team performance was conceptualized as the ability of project team members to achieve the project's goals (Buvik & Rolfsen, 2015). Notably, team performance differs from project performance, which refers to the attainment of project goals in relation to indicators or metrics such as project budget, quality of deliverables, and time to project completion (Cooke-Davies, 2002). Essentially, team performance is centered on aspects of team members' productive capacity, their satisfaction with the team and its operations, and cooperation among them. Thus, team criteria was used as the principal to measure team perfromance. Team performance is impacted by team criteria scores (rated scores between team members), which dictates the team perfromance level of a construction team. This research sought to accomplish two aims: first, to explore what personality traits influence team performance on construction projects (research question three) and, second, to determine the accuracy of personality traits and team criteria influencing team performance on construction projects (research question four).

The conditions (or configurations) and explanations for exploring high or low team performance in construction projects were based on eight case studies from LaDOTD transportation construction projects. Although more comparative investigation is necessary to further support the findings in this research, this research uncovered several implications for further exploring team performance in construction projects.

First, the QCA results of personality traits, at the individual and team levels, indicated that none of the big five personality traits could individually impact team performance in the analysis of necessity and sufficiency. Trust and respect (TRP) and commitment and responsibility (CRP) were the only conditions that can individually impact team performance at the individual level as necessary conditions. At the team level, only TRP was the condition that could impact team performance as a necessary condition. Conversely, personality traits in combination with team criteria consistently influenced team performance at both individual and team levels, but at lower relevance scores to necessity. The configurations that had personality traits. The following configurations, that involve personality traits, were found to be necessary for high team performance at the team level:

- The presence of agreeableness or of shared values, goals, and culture (AG + SVGC).
- The presence of openness to experiences or of shared values, goals, and culture (OP + SVGC).
- The absence of extroversion or of communication and information sharing (~EX + CIS).
- The presence of agreeableness or of commitment and responsibility (AG + CRP)
- The presence of agreeableness or of communication/information sharing (AG + CIS).

Though personality traits in the above configurations presented high inclusion scores for necessity, they also presented low relevance scores, which indicates the configurations were necessary but not as significant to necessity as team criteria conditions. This signifies that their high inclusion scores do not guarantee these configurations will appear in all the case studies and would in fact appear only in some. This does not diminish the importance of personality traits, but it does guarantee that when these configurations are present in construction teams, the personality traits in the configurations are necessary for high team performance.

Second, the analysis sufficiency (intermediate solution) assisted in fully answering question three by confirming and identifying that agreeableness (AG), conscientiousness (CO), and openness to experience (OP) are sufficient (or influential) for high team performance in construction project teams. It also suggested that AG, CO, and OP are most effective when combined with team member satisfaction (TMS) and trust/respect (TRP). Furthermore, the analysis sufficiency also confirmed that trust and respect (TRP) is the one condition that must be present in all configurations for achieving high team performance. The absence of trust and respect (TRP) among construction teams guarantees low team performance according to the findings of this research.

The findings regarding the impact of personality traits on team performance are novel, considering the limited empirical research conducted on personality traits and construction project team performance. The following sections deal with the comparison of the QCA findings and interviews to the literature to confirm or disconfirm the findings. This comparison also assisted in fully addressing question four of this research, and the interviews provided face validity of the findings. The supplemental analysis (logistic fit models and factorization of the principal components) also assisted in demonstrating accuracy of the findings with other analysis procedures.

The QCA intermediate solution results included agreeableness (AG) as a part of the solution. AG was found to be sufficient to produce positive team performance in this research. High scores on AG, at the team level, are characterized as the presence of high vitality, team members being concerned for the success of the team, better conflict resolution, team members getting along, team members being trusting of each other, and the presence of open communication (Ghani, Yunus, & Bahry, 2016; Juhász, 2010; Kamdar & Dyne, 2007; Neuman & Wright, 1999; Schippers, 2012). These characteristics were observed during the interviews in three case studies (XK9DJ, 59HQR, and 0AQD7) in which high team performance was noted. Team members in these case studies got along well, communicated often, and trusted each other due to their ability to complete work and honor their promises. The findings regarding AG in this study were also consistent with the literature. Rhee, Parent, and Basu (2013) found that scores above average in teams demonstrated less conflict, and case studies XK9DJ, 59HQR, and 0AQD7's team level scores for AG were above average compared to the rest of the case studies. Driskell et al. (2006) indicated that team members high in AG tend to be honest, trusting, supportive, and considerate of other team members; honesty was one of the characteristics that helped build trust and satisfaction among team members in this research according to the interviews. Furthermore, this is consistent with Juhász (2010) who suggested that team members who are high in trust are relied on by others to be always honest; they are also dependable as they are concerned with the team's well-being.

Conscientiousness (CO) was found to be sufficient to produce positive team performance in this research. High scores of CO are characterized by team members being engaged in goals, detailed performance in tasks, high job satisfaction, and high levels of organization (Ghani et al., 2016; Juhász, 2010; Kamdar & Dyne, 2007; Neuman & Wright, 1999; Schippers, 2014). High scores in CO were observed in case studies 59HQR and 0AQD7, which had high team performance and above average CO scores. The interviews further confirmed the findings and were consistent with the literature. Team members in 59HQR and 0AQD7 commented that job satisfaction existed because of their good work performance, quality of work, timely completion of projects, and being knowledgeable in construction. Consistent with Juhász (2010), O'Nneill and Allen (2011), and Bell (2007) also found that CO was significantly related to team performance because of its nature of dutifulness, organization, and achievement of goals. Bell (2007) indicated that conscientiousness allows project managers, project team leaders, and other authoritative figures in construction projects to effectively and efficiently assign tasks, monitor progress, and report performance. Essentially, conscientiousness denotes the tendency of project team members to be organized in their activities, such as through proper assignment of tasks and responsibilities. Absence of conscientiousness would imply project team members lack a sense of direction regarding where the project is heading and their expected scope of responsibility in achieving team objectives.

Openness to experience (OP) was also found to be sufficient to produce positive team performance. High scores of OP were observed in case studies XK9DJ, 59HQR, and 0AQD7 with high team performance. High levels of OP are characterized in team members who generate noble ideas, do not avoid conflict, are flexible to changes, possess high levels of adaptability, and promote open communication (Ghani et al., 2016; Juhász, 2010; Kamdar & Dyne, 2007; Neuman & Wright, 1999; Schippers, 2012). The interviews in these cases studies also provided supporting evidence of OP's characteristics. Team members in case studies XK9DJ, 59HQR, and 0AQD7 promoted high communication, supported each other by cooperating during conflict, and were flexible when problems arose. The findings regarding OP in this research were consistent with Juhász (2010), who found a high correlation between team-oriented communication and learning new things (which explains why team members were flexible in this research). It was also consistent with Bradley, Klotz, Postlethwaite, and Brown (2013), who found that team members who scored high on OP understood conflict in their teams better and thus had a positive impact on team performance.

Another noticeable finding was related with extroversion (EX). Based on the meta-analysis conducted, it was observed that extroversion was a personality trait that has a positive and significant effect on team performance. According to Bradley et al., (2012), extroversion allows project team members to maintain team cohesiveness, establish high levels of communication and coordination, and resolve issues as a team finding constructive solutions. However, from the analysis performed in this research, it was found that extroversion did not appear among the conditions that can account for high team performance in construction project teams. One of the possible reasons for the difference between what has been widely reported in existing literature and what was found in the current study is the methodological approach used. In the literature, most studies used traditional, ordinary least squares approaches to determine the association between personality variables and team performance. This study applied a qualitative, comparative analysis approach along with regression statistical approaches and factorization of the principal components based on variable correlations. Additionally, most studies that reported a positive association between extroversion and team performance were not conducted in the construction industry. For instance, in their study, Juhász (2010), focused on the impact of personality traits on team performance in the business sector wherein subjects were trainees. Even though the findings of Juhász (2010) indicated EX to be a significant predictor of positive team performance, the study was not related to the construction industry. However, O'Neille and Allen (2010) and other studies found EX to be a poor predictor of team performance even though O'Neille and Allen's (2010) subject were students. Therefore, the results of this study more closely resemble O'Neille and Allen's study and better represents the team performance of construction project teams.

Moreover, while analyzing personality traits, it was observed that the presence of conscientiousness or team member satisfaction (CO + TMS) at the individual level and the absence of conscientiousness or presence of commitment and responsibility (~CO + CRP) were necessary conditions for high team performance. However, these results show a contradiction at the individual and team levels. For the team level, the results revealed the absence of conscientiousness was a necessary condition for high team performance, while for the individual level, the presence of conscientiousness was a necessary condition for high team performance. The lack of congruence may be a result of the low scores on relevance of necessity for both solutions. For instance, the configuration of the presence of conscientiousness or the presence of team member satisfaction (CO + TMS) had a relevance score of 63.6%, implying that the remaining 36.4% could include any other combination including those configurations containing the absence of conscientiousness condition. Though the literature supported that in some instances having all team member high on conscientiousness could be detrimental to team performance (Rhee et al., 2013; Toh & Miller, 2016), more case studies are needed to confirm the absence of conscientiousness at the team level in construction projects.

Based on the findings, the sampled case studies confirmed that the most influential personality traits on team performance in construction projects are agreeableness, conscientiousness, and openness. It was confirmed with the QCA's intermediate solution and internally verified with the principal component analysis, factorization of the principal components, and team members' interviews. Though personality traits were not exceptionally significant on their own in this research, it can be inferred that their influence on team performance is positive when combined with team criteria. Moreover, personality traits are deeply intercorrelated with team criteria because of a person's behavior, which controls their willingness to collaborate with the team or not. Combining different personality traits among construction teams, especially AG, CO, and OP, can impact team performance because each personality trait offers good behavior. For example, it was concluded in this study that trust/respect is the most critical condition for positive team performance. It was also established that AG is significantly correlated with trust/respect. Thus, having high AG levels can promote or maintain high team performance because people with high AG are soft-hearted, trusting, and helpful. In construction projects, high reliability and dependability are critical among team members to maintain team performance. Other investigations such as Courtright et al. (2017), Toh & Miller (2016), Kramer et al. (2014), Guchait et al. (2014), Schippers (2014), Rhee, Parent, & Basu (2013), and Bradley et al. (2012) investigated personality influence on team performance using students as subjects. Their findings are not less meaningful than the findings in this research. However, if a student fails to perform in a team, the consequences are not as severe since other students can pick up the workload from the failing student.

On the other hand, a failing or less collaborative team member has severe consequences to the construction team's performance in construction projects. The main reason is due to the high level of knowledge and skill team members possess. Also, there is a contractual obligation that is tied to a price. None of these are easily replaced or pickable by another team member, thus resulting in disputes and low team performance. Therefore, this study offers much more resounding and relatable findings to the construction industry because real construction projects were used. The results can be used by construction stakeholders looking to improve team performance based on personalities or promote more research on this topic, which is needed in the construction industry. How could this study assist construction stakeholders? This research could help construction stakeholders evaluate team members and determine if their personalities could help the construction team or not. It is crucial to understand if the construction team personality mix will contribute to high team performance. The evaluation should give construction stakeholders a much deeper understanding of how to supplement the team by adding or replacing team members to obtain positive team performance. It is essential to mention that personality assessment is being performed in other industries, as discussed previously. This research adapted what other studies have done and successfully explored how it could be implemented in the construction industry. Since the construction industry has not explored personality influence on team performance in-depth, this research offers an initial stepping stone to investigate personality further, develop a more specific personality questionnaire, and create a questionnaire database specifically for the construction industry. Such investigation would expand the comprehension of how personality differences in construction teams can impact team performance. With the continuing exploration of personality and its combination with team criteria, a robust prediction model could be created to predict team performance focusing on team members' personality differences. This study's contribution was determining what personality traits influence team performance and successfully determined that agreeableness, conscientiousness, and openness to experience are the traits needed for positive team performance in construction projects. This research determined which aspects of agreeableness, conscientiousness, and openness to experience were intercorrelated with team criteria with the information provided by previous investigations.

The main aspects of agreeableness, conscientiousness, and openness to experience offer to the construction industry to reinforce team criteria are in the followings:

- Agreeableness (AG): This study revealed that AG is the essential trait, significantly correlated with trust/respect, team member satisfaction, and shared values/goals/culture. The literature demonstrated that AG predicts team performance, but it was not the most predictable trait. However, the sampled case studies found that AG is the most influential in construction projects. AG's aspects that strengthen team criteria are 1) concern for team success, 2) trust among team members, 2) conflict resolution, 3) open communication, 4) flexibility to changes, 5) harmony among team members, and 6) less competition among team members.

- Conscientiousness (CO): This study revealed that CO is an essential trait significantly correlated with team member satisfaction and trust/respect. The literature demonstrated that CO is the most predictable trait for team performance. However, in this research, CO was the second most influential trait in construction projects. CO's aspects that strengthen team criteria are 1) engagement in planning goals, 2) perform tasks in detail, 3) enthusiasm among team members, 4) highly organized teams, 5) high job satisfaction, and 6) higher levels of productive behavior.

- Openness to experience (OP): This study revealed that OP is the third essential trait, highly correlated with AG and CO. Though OP was not significantly correlated with team criteria, the analysis results showed that its significant correlation to AG and CO was enough to be part of the intermediate solution in QCA. OP's aspects that strengthen team criteria are 1) generation of noble solutions, 2) team members do not avoid conflict and approach it with collaboration, 3) high flexibility to changes, 4) high levels of adaptations, 5) and open discussion among team members.

As mentioned earlier, personality traits were not found to be sufficient on their own for team performance but in combination with team criteria. Analysis of findings for both team criteria and personality traits at the individual level indicated that the presence of shared values, goals or the presence of communication and information sharing is a necessary condition for high team performance. Consequently, high project team performance may not be realizable if shared values, goals, and culture and communication and sharing information are both low. Past research has also reported similar findings indicating that these are among the most important factors influencing positive team performance (Korkmaz et al., 2012; Kumaraswamy et al., 2005). In particular, Korkmaz et al. (2012) reiterated that shared goals and values among project team members enhance cooperation and coordination, which ultimately improves team performance. Additionally, Franz et al. (2016) indicated that shared values, goals, and culture among team members is boosted by regular communication and sharing of critical information among team members. In construction projects, coordination and communication also reduces the chances of errors while maximizing the probability of project success (Albanese, 1994; Barry et al., 1997; Che Ibrahim et al., 2015; Franz et al., 2016; Harper et al., 2016; Korkmaz et al., 2012; Kumaraswamy et al., 2005; Rotimi et al., 2015; Spatz, 2000). On the contrary, construction projects in which team members do not engage in regular communication and information sharing, there is likely to be a lack of congruence in terms of goals, values, and culture. Therefore, construction projects with reduced information sharing and communication capacity may not successfully produce the expected deliverables as each team member would be pursuing their own unique goals and objectives using different means. QCA expanded on these findings by demonstrating that the combination of personality traits such as agreeableness and conscientiousness and openness to experience and team member satisfaction and trust/respect (AG*CO*OP*TMS*TRP) present an extremely high likelihood of achieving team performance, and their negation is just as truthful which was demonstrated in this research.

The findings showed that the presence of trust and respect leads to high team performance while its absence leads to low team performance. Trust and respect define the extent to which a team member perceives the other to be of importance to the team (Rotimi et al., 2015). Furthermore, Korkmaz et al. (2012) defined trust and respect as the admiration that a team member has towards another member due to the other team member's level of skill, competence, qualities, or past achievements. According to previous research, trust and respect motivates team members to perform their tasks more efficiently and effectively and to remain committed towards common project goals (Albanese, 1994; Korkmaz et al., 2012; Kumaraswamy et al., 2005; Spatz, 2000). On the one hand, the respected party feels appreciated for possessing certain skills or achieving particular objectives that are deemed important for successful project completion. On the other hand, the respecting party becomes motivated by the need to develop skills and competencies deemed important to the project team to earn the respect of other members (Spatz, 2000). Therefore, this research, consistent with previous research, illustrated that trust and respect is considered an important factor for attaining high project team performance. The QCA demonstrated that trust and respect is the only condition which can help achieve high team performance even in the absence of all other factors. Though this seems to be true according to the results of this research, the research believes that trust and respect requires personality traits for team members to trust each other, especially for agreeableness to exist. This conclusion was reached based on the interviews. Many team members commented that trust and respect was gained through interactions, by getting along with each, being flexible, completing tasks, honoring promises, maintaining constant communication, and assisting each other when problems occur. As Juhász (2010), Driskell et al. (2006), and Rhee et al. (2013) stated, these interactions are very consistent with agreeableness. Thus, high agreeableness must be a part of the team's essence to achieve high levels of trust/respect, which has been pointed out in this research as a necessary condition for high team performance.

Additionally, it was observed that trust and respect was not necessarily constrained to previous working experience. Team members from the case studies shared in the interviews that trust and respect was created through the completion of tasks, being responsible to one another, honoring contractual obligations, high quality of work, open communication/interactions, finishing projects effectively, keeping promises, cooperating with one another, and supporting each other. In other words, the greater the team members' satisfaction with each other, the quicker trust and respect builds without a time constraint. Some team members attain trust and respect within a year of working together, while others with more than twenty years of sharing a relationship demonstrate moderate or low levels of trust.

5.4 Implications of Findings

The findings of the current study have practical implications for different stakeholders in the construction sector. In the construction industry, it is important that team members develop trust and respect through different strategies to ensure they are united under a single culture, set of values, and goals to achieve optimum team performance. In particular, embracing shared goals, values, and culture can improve project quality, sustainability, collaboration, and cost effectiveness. Consequently, project team members must ensure they cultivate a culture of shared values and goals. According to Korkmaz et al. (2012), one of the approaches to facilitate sharing of values and goals is by sharing information and communication. Communication and information sharing allows team members to build a wealth of information and knowledge within their team; thus, it maximizes their ability to understand each other and establish their common goals as a team. Consistent with the findings of this current study, teams can achieve high team performance if team members communicate and share critical information with each other (Driskell et al. 2006; Franz et al. 2016; Juhász, 2010, Korkmaz et al., 2012; Kumaraswamy et al., 2005). Furthermore, satisfaction of team members is equally important to build trust and respect among team members.

The current study also showed that the presence of trust and respect and commitment and responsibility lead to high team performance. Essentially, team members are expected to inculcate elements of trust and respect and commitment and responsibility among one another. However, gaining trust and respect among team members in construction projects is quite challenging. According to Franz et al. (2016), trust is developed gradually as people work together for long periods. However, in construction projects, teams normally change from one project, deliverable, or task to another. Nevertheless, construction team members must be flexible enough to build trust within relatively shorter durations to ensure project team performance is maximized. Ibrahim et al. (2015) asserted that trust building must begin with the project team leader who should allow members to freely express their views and make contributions to the project. Similarly, project team members are expected to trust and respect each other so that they can collaborate towards the achievement of the project goals.

In terms of personality traits impacting team performance, the presence of agreeableness along with shared values, goals, and culture leads to high team performance. High agreeableness is characterized by a polite, friendly, and cooperative personality (Goldberg, 1992) at the individual level. At the team level, high agreeableness is characterized by high vitality, concern for others, trust among team members, better conflict resolution, open communication, flexibility, team members work well with each other, and less competition among team members (Courtright et al., 2017; Schippers, 2014; Juhász, 2010; O'Neill & Allen, 2010). According to Goldberg (1992), people who exhibit high agreeableness are easier to communicate with and subsequently share information with. Shared values, goals, and culture, in turn, is characterized by pursuing common goals and values under the same culture.

Apart from agreeableness, openness to experiences, conscientiousness, extroversion, and neuroticism may also impact team performance when combined with team criteria. However, to reduce the complexity in the required conditions for high team performance, project teams may consider cultivating a culture of team members' satisfaction in their respective teams in case the combination of any personality trait is difficult to implement. As observed in the interviews, highly satisfied team members lead to the building of trust and respect quicker. Trust and respect, in turn, stand out as the primary team criteria that helps attain high team performance. Therefore, project team leaders and members should ensure they trust and respect each other to guarantee high performance.

5.5 Limitations

While this study achieved the project objectives and answered the research questions, there are limitations to this study.

- The study was restricted to the transportation construction sector within the United States with the target population including project managers, project engineers, inspectors, consultants, superintendents, and contract administrators. Restricting the study to the transportation construction sector limits the generalizability of the findings to only this particular sector. However, limiting the study's context to the transportation construction sector was intended to fill an existing gap in the literature pertaining to the effect of personality traits on project team performance. Furthermore, transportation construction projects tend to use public funds, and determining ways to improve performance helps ensure that taxpayers' money is utilized efficiently.
- The study included a limited sample size of 38 participants and eight case studies. This sample size is relatively small for inferential parametric statistics such as hierarchical and multinomial regression. However, the primary analysis used was qualitative comparative analysis, which is less sensitive to sample size requirements.

- Conducting the case studies was complicated by the COVID-19 pandemic. The original plan consisted of onsite observation of the team members. The purpose was to use the findings from the observation to validate the quantitative findings. However, due to COVID-19, the observation part could not be performed as the site was only accessible to essential personnel.
- Although 10 interviews were conducted, only one general contractor representative volunteered for an interview. The nine remaining interviews included transportation agency staff, which renders the perspective relatively one-sided.
- The calibration threshold for team criteria conditions was based on the relative position of the sampled case studies. The researcher suggests that further research needs to be conducted to properly select the calibration thresholds based on geographical location, education, years of experience, and project complexity. Geographical location and project complexity were recommended because team members behave differently and perform differently if they do not like the project's location and if the project is difficult to build.
- This study requires further review by external experts to better access the quality of the findings. Due to this reason, this research is considered as a pilot study. Consequently, this pilot study presents only a small-scale preliminary research conducted to access the influence of personality traits and team criteria on team performance in real construction projects, a subject on which there are very few studies and this study aimed to fill that gap.

5.6 Recommendations

This study investigated the impact of the big five personality traits and team criteria on team performance for transportation construction project teams. Based on the findings, the following recommendations are offered for practitioners to consider boosting project team performance.

- It is evident that personality differences exist in construction project teams and that similarities in personality could negatively impact team performance. Thus, this research demonstrated that project stakeholders (LaDOTD and general contractors) should invest in understanding personality to access team performance before, during, or after construction. Greater emphasis should be paid towards building agreeableness, conscientiousness, and openness to experiences within the project as these traits, when present, can lead to higher team performance.
- Project team members should be oriented on appropriate team criteria conditions, trust and respect, team member satisfaction, shared values, goals, and culture, communication and information sharing, and commitment and responsibility. As this study demonstrated, trust and respect is a primary factor that can lead to high team performance when present and low team performance when absent. Establishing trust and respect among the project team members should be required by project team leaders.

5.7 Future Research

Considering the limitations of the current study, the researcher presents several recommendations for future research.

- Future research can consider replicating the study in different sectors of construction along with a larger sample size. Increasing the same size will help the regression analyses produce valid results, while investigating other sectors of construction may produce different results that can be compared to the results of this study.
- Based on the interviews conducted, future research can consider including other field personnel such as subcontractors, consultants, foremen, and quality control technicians

since many of the owner's representatives have a much stronger relationship with them. This could help in gaining a better understanding of how the team keeps functioning when team leaders share adverse relationships with other members.

- Observations could not be conducted in this research due to the COVID-19 pandemic. Therefore, future research should include field observations to rate the interactions between team members. These observations will allow a robust external rating of the interaction, which will help add further face validity to the findings beside the interviews.
- The interviews revealed that construction knowledge was part of team members' satisfaction. Thus, future research should incorporate construction knowledge of the team members to better understand if construction knowledge actually facilitates building trust/respect and increasing shared values/goals/culture among team members.
- Future research should also examine whether team performance influences cost and time. The analysis should be based on how long it takes for team members to react, evaluate, find solutions, and implement solutions when problems occur. Change orders are not a good measure of cost and time because the majority are based on design errors or unforeseen events. Measuring interaction time between team members would offer a better assessment of how well team members invest their time in the construction project. Time interaction can easily be translated to cost and would thus allow accessing cost impacts due to time loss in unnecessary interactions.

5.8 Summary

Since team performance is an important factor in the construction industry, it is imperative that stakeholders understand how personality differences can positively or negatively influence team performance. This research demonstrated that trust and respect is the most important condition to achieve high team performance. Trust encompasses commitment, competence, communication, and collaboration, while respect is gained through the completion of tasks and honoring promises. It was also demonstrated that team performance is mediated by a combination of personality and team criteria conditions – they offer a higher consistency score to achieve high team performance. Though personality traits were not found to be influential on teams on their own, this study presented that agreeableness could assist in building trust and respect among team members. Though this study had several limitations, the study provided strong evidence that personality along with team criteria positively influence team performance in construction projects. The researcher encourages other investigators in the construction industry to embark on future research based on the suggestions offered in this study, especially with regard to conducting observations. Finally, team performance in this research, as an output, was found to be directly influenced by trust and respect and its absence was found to be detrimental to team performance.

APPENDIX I. LIST OF THE 33 STUDIES SELECTED FOR META-ANALYSIS

Study #	Authors	Title
1	(Juhász, 2010)	Influence of personality on Teamwork behaviour and communication
2	(O'Neill & Allen, 2010)	Personality and the Prediction of Team Performance
3	(Mohammed & Angell, 2003)	Personality Heterogeneity in Teams: Which Differences Make a Difference for Team Performance?
4	(Guchait et al., 2014)	Personality predictors of team taskwork understanding and transactive memory systems in service management teams
5	(Bradley et al., 2012)	Ready to Rumble: How Team Personality Composition and Task Conflict Interact to Improve Performance
6	(Toh & Miller, 2016)	Creativity in design teams: the influence of personality traits and risk attitudes on creative concept selection
7	(Varvel, Adams, Pridie, & Ruiz Ulloa, 2004)	Team Effectiveness and Individual Myers-Briggs Personality Dimensions
8	(Rhee, Parent, & Basu, 2013)	The Influence of Personality and Ability on Undergraduate Teamwork and Team Performance
9	(Alessandri & Vecchione, 2012)	The higher-order factors of the Big Five as predictors of job performance
10	(Hirschfeld, Jordan, Thomas, & Feild, 2008)	Observed Leadership Potential of Personnel in a Team Setting: Big Five traits and proximal factors as predictors
11	(Kramer et al., 2014)	Personality and group performance: The importance of personality composition and work tasks
12	(Bolin & Neuman, 2006)	Personality Process and Performance in Interactive Brainstorming Groups
13	(Morgeson, Reider, & Campion, 2005)	Selecting Individuals in Team Settings: The Importance of Social Skills, Personality Characteristics, And Teamwork Knowledge
14	(LePine, 2003)	Team Adaptation and Postchange Performance: Effects of Team Composition in Terms of Members' Cognitive Ability and Personality
15	(Oh & Berry, 2009)	The Five Factor Model of Personality and Managerial Performance: Validity Gains Through the Use of 360 Degree Performance Ratings
16	(Neuman, Wagner, & Christiansen, 1999)	The Relationship Between Work-Team Personality Composition and the Job Performance of Teams
17	(Scotter et al., 2011)	A Multi-Level examination of supervisors' and subordinates' personality and role behavior: Implications for work group effectiveness
18	(Porter et al., 2003)	Backing Up Behaviors in Teams: The Role of Personality and Legitimacy of Need
19	(Gonzalez-Mulé, Degeest, Mccormick, Seong, & Brown, 2014)	Can We Get Some Cooperation Around Here? The Mediating Role of Group Norms on the Relationship Between Team Personality and Individual Helping Behaviors
20	(Barry & Stewart, 1997)	Composition, Process, and Performance in Self-Managed Groups: The Role of Personality
21	(Peeters et al., 2008)	Designing in Teams: Does Personality Matters?
22	(Kickul & Neuman, 2000)	Emergent Leadership Behaviors: The Function of Personality and Cognitive Ability in Determining Teamwork Performance and KSAS
23	(Halfhill, Nielsen, Sundstrom, & Weilbaecher, 2005)	Group Personality Composition and Performance in Military Service Teams
24	(Hu & Judge, 2017)	Leader–team Complementarity: Exploring the Interactive Effects of Leader Personality Traits and Team Power Distance Values on Team Processes and Performance
25	(Tasa, Sears, & Schat, 2010)	Personality and teamwork behavior in context: The cross-level moderating role of collective efficacy
26	(Courtright, McCormick, Mistry, & Wang, 2017)	Quality Charters or Quality Members? A Control Theory Perspective on Team Charters and Team Performance
27	(Barrick, Stewart, Neubert, & Mount, 1998)	Relating Member Ability and Personality to Work-Team Processes and Team Effectiveness
28	(Schippers, 2014)	Social Loafing Tendencies and Team Performance: The Compensating Effect of Agreeableness and Conscientiousness
29	(Kamdar & Van Dyne, 2007)	The Joint Effects of Personality and Workplace Social Exchange Relationships in Predicting Task Performance and Citizenship Performance
30	(Bond & Shiu, 1997)	The Relationship Between a Group's Personality Resources and the Two Dimensions of Its Group Process
31	(Neuman & Wright, 1999)	Team Effectiveness: Beyond Skills and Cognitive Ability
32	(Li et al., 2015)	Collective-efficacy as a mediator of the relationship of leaders' personality traits and team performance: A cross-level analysis
33	(Ghani, Yunus, & Bahry, 2016)	Leader's Personality Traits and Employees Job Performance in Public Sector, Putrajaya

APPENDIX II. DEMOGRAPHIC RAW DATA

n	Code	Agency/Firm	Role	Education	Age	Years of Experience
1	0AQD7-OW-GC-1	Owner	Project Engineer	Bachelor's Degree	18 - 30	7
2	0AQD7-GC-OW-2	General Contractor	Project Manager	High School Diploma	31 - 40	5
3	0AQD7-OW-OW-3	Owner	Inspector	Bachelor's Degree	18 - 30	2
4	4DH7W-OW-OW-1	Owner	Inspector	Some College	41 - 50	13
5	4DH7W-OW-OW-2	Owner	Project Engineer	Bachelor's Degree	31 - 40	1
6	4DH7W-OW-OW-3	Owner	Inspector	Some College	41 - 50	21
7	4DH7W-OW-GC-4	Owner	Inspector	High School Diploma	18 - 30	3
8	4DH7W-GC-OW-5	General Contractor	Project Manager	Bachelor's Degree	18 - 30	3
9	59HQR-OW-OW-1	Owner	Inspector	Some College	41 - 50	1
10	59HQR-OW-OW-3	Owner	Inspector	High School Diploma	18 - 30	8
11	59HQR-OW-OW-5	Owner	Project Engineer	Bachelor's Degree	31 - 40	1
12	59HQR-GC-OW-6	General Contractor	Superintendent	High School Diploma	41 - 50	30
13	59HQR-OW-GC-7	Owner	Inspector	High School Diploma	18 - 30	3
14	59HQR-OW-GC-8	Owner	Inspector	Some College	41 - 50	21
15	5M2N7-OW-GC-1	Owner	Inspector	High School Diploma	31 - 40	12
16	5M2N7-GC-OW-2	General Contractor	Project Manager	High School Diploma	31 - 40	5
17	5M2N7-OW-GC-3	Owner	Inspector	High School Diploma	18 - 30	5
18	9BW2Q-OW-GC-1	Owner	Project Engineer	Master's Degree	41 - 50	5
19	9BW2Q-OW-GC-2	Owner	Project Manager	Master's Degree	31 - 40	2
20	9BW2Q-OW-GC-3	Owner	Inspector	Bachelor's Degree	31 - 40	5
21	9BW2Q-GC-OW-4	General Contractor	Project Manager	Bachelor's Degree	31 - 40	9
22	9BW2Q-OW-OW-5	Owner	Contract Administrator	High School Diploma	41 - 50	22
23	9BW2Q-OW-GC-7	Owner	Inspector	High School Diploma	31 - 40	19
24	Q97Y2-OW-OW-1	Owner	Project Engineer	Bachelor's Degree	51 - 60	25
25	Q97Y2-OW-GC-3	Owner	Inspector	Some College	31 - 40	8
26	Q97Y2-GC-OW-4	General Contractor	Superintendent	Some College	41 - 50	25
27	TW1RK-OW-OW-1	Owner	Project Engineer	Bachelor's Degree	18 - 30	6
28	TW1RK-GC-OW-3	General Contractor	Project Manager	Some College	31 - 40	14
29	TW1RK-GC-OW-4	General Contractor	Superintendent	High School Diploma	41 - 50	30
30	XK9DJ-OW-OW-1	Owner	Project Engineer	Master's Degree	41 - 50	5
31	XK9DJ-OW-OW-3	Owner	Inspector	Bachelor's Degree	18 - 30	3
32	XK9DJ-GC-OW-4	General Contractor	Superintendent	High School Diploma	41 - 50	25

APPENDIX III. PERSONALITY RAW DATA T1 AND T2

case	time	id	e1	e2	e3	e4	e5	e6	e7	e8	e9	e10
	a1	a2	a3	a4	a5	a6	a7	a8	a9	a10	c1	c2
	c3	c4	c5	c6	c7	c8	c9	c10	n1	n2	n3	n4
	n5	n6	n7	n8	n9	n10	o1	o2	o3	o4	o5	o6
	o7	o8	o9	o10								
OAQD7-1	1	1	3	4	4	3	3	3	4	4	2	
	3	2	4	3	3	2	4	2	4	3	4	2
	4	4	2	3	2	4	2	4	4	2	4	3
	4	2	2	2	2	2	2	3	4	2	4	2
	3	2	2	2	4							
OAQD7-2	1	2	3	2	4	4	4	2	5	5	1	
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	3	2	4	2	2	2	3	4	2	2	4	2
	4	2	4	2	5							
OAQD7-3	1	3	3	2	2	3	1	3	2	4	2	
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	1	4	1	4	1	5	2	4	3	3	4	2
	2	2	2	2	1	3	1	4	4	2	4	3
	4	2	4	2	4							
4DH7W-1	1	4	3	4	4	4	3	4	2	5	2	
	5	1	4	1	5	2	4	2	4	4	4	5
	2	5	1	5	1	5	1	5	5	4	2	4
	2	3	3	1	2	1	3	4	5	2	5	1
	5	1	2	3	5							
4DH7W-2	1	5	3	3	3	3	3	3	3	3	3	
	3	2	3	1	4	2	3	3	3	3	3	4
	3	4	2	4	2	4	2	4	4	2	3	3
	3	3	3	3	3	3	2	4	3	3	4	3
	4	2	4	3	4							
4DH7W-3	1	6	3	3	4	3	3	3	3	3	3	
	3	3	3	3	3	3	3	3	3	3	3	3
	3	3	3	3	3	3	3	3	3	3	3	3
	3	3	3	3	3	3	3	3	3	3	3	3
	3	3	3	3	3							
4DH7W-4	1	7	1	5	2	3	1	5	1	5	1	
	5	3	3	3	3	3	4	3	3	3	3	3
	2	3	2	3	2	4	3	4	4	1	5	1
	5	1	1	1	1	1	1	2	2	3	3	3
	3	3	4	2	2							
4DH7W-5	1	8	4	1	4	1	4	2	4	2	4	
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	3	2	1	2	1	2	2	4	3	3	4	3
	3	2	4	3	4							
59HQR-1	1	9	1	4	4	3	2	4	2	4	2	
	4	1	4	1	5	2	4	2	4	4	4	4
	2	5	1	5	1	5	1	5	4	4	2	4
	3	2	1	1	1	1	2	4	4	2	4	2
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59HQR-2	1	10	3	4	5	3	4	4	2	3	3
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3	4	2	3	2	4	2	4	4	3	4	4
4	2	1	2	1	1	2	5	5	2	4	2
4	2	4	4	4							
59HQR-3	1	11	4	2	4	2	4	2	4	3	3
4	2	4	1	4	2	4	2	4	4	4	4
2	4	2	4	2	4	2	3	2	2	4	3
4	2	2	2	2	2	2	4	3	2	4	3
3	2	4	2	3							
59HQR-4	1	12	3	3	4	3	3	3	4	3	3
3	4	4	3	4	3	3	3	4	3	3	4
2	5	2	4	2	4	2	4	4	3	3	3
3	2	2	2	2	2	2	4	4	2	4	3
4	3	3	3	3							
59HQR-5	1	13	5	1	5	1	5	2	4	4	4
1	1	5	1	5	1	4	1	4	4	5	4
1	5	1	5	1	5	1	4	4	1	5	1
1	1	1	1	1	1	1	5	4	1	4	1
4	1	5	4	5							
59HQR-6	1	14	4	1	5	2	5	2	1	1	5
1	4	3	3	1	5	2	5	1	1	4	5
2	5	2	4	4	5	1	5	5	3	4	3
2	1	2	2	1	1	1	4	4	3	5	2
5	1	4	4	3							
5M2N7-1	1	15	3	4	4	4	4	2	4	4	4
4	4	4	2	4	4	4	4	4	2	4	4
2	4	4	4	2	4	4	4	4	2	4	2
4	2	2	2	2	2	2	4	2	2	4	2
3	2	4	2	4							
5M2N7-2	1	16	3	2	4	4	4	2	4	5	1
4	1	4	1	4	2	4	1	5	3	4	4
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3	2	4	2	4							
5M2N7-3	1	17	3	3	3	4	3	3	4	3	2
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3	4	2	4	2	4	2	4	4	2	4	2
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4	2	4	3	4							
9BW2Q-1	1	18	4	2	4	2	4	2	5	2	4
2	1	4	2	4	2	5	2	4	4	4	3
2	3	3	3	4	4	2	4	3	2	4	2
4	4	2	3	3	2	2	4	3	2	4	3
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9BW2Q-2	1	19	1	4	3	3	2	3	3	3	2
4	2	3	2	5	2	4	2	4	5	4	4
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2	2	2	3	3	2	4	4	4	2	4	2
4	2	4	4	5							
9BW2Q-3	1	20	2	3	4	2	4	2	3	3	3
3	1	4	1	4	3	3	2	4	4	4	4

1	4	1	4	1	5	2	4	4	2	3	4
3	3	3	2	1	1	1	4	3	2	4	3
4	2	4	3	3							
9BW2Q-4	1	21	3	4	4	2	4	2	3	4	4
2	2	4	2	4	2	4	2	5	4	3	3
2	4	2	4	2	5	3	4	4	3	2	4
3	2	2	2	2	2	2	3	2	2	3	2
3	4	3	2	4							
9BW2Q-5	1	22	3	2	5	1	4	1	3	4	4
3	2	3	1	4	3	2	3	4	3	3	5
1	5	1	5	1	5	3	5	5	2	4	4
3	4	3	4	3	4	2	4	3	3	4	2
4	4	3	2	4							
9BW2Q-6	1	23	4	2	4	2	5	3	4	3	3
3	3	3	3	3	3	3	3	3	3	3	5
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3	3	3	3	2	2	2	4	3	3	3	2
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Q97Y2-1	1	24	3	4	2	4	2	3	2	5	4
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3	4	2	3	3	4	2	3	3	2	4	3
3	3	2	3	2	3	2	4	4	2	4	2
4	2	4	3	4							
Q97Y2-2	1	25	4	2	4	3	2	2	2	3	4
2	1	3	3	2	3	2	3	4	3	3	4
1	4	1	3	3	5	3	4	4	5	3	4
3	2	3	2	2	3	2	4	3	3	5	5
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Q97Y2-3	1	26	5	1	5	1	5	1	5	3	4
1	2	5	1	4	2	3	2	5	4	5	4
1	4	2	5	1	5	2	5	5	2	4	2
2	2	1	1	1	1	2	4	5	2	5	2
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TW1RK-1	1	27	2	4	2	3	4	4	1	3	2
5	1	4	3	3	2	4	2	3	3	3	4
5	4	3	2	4	4	2	2	4	3	4	4
4	4	2	2	1	3	1	3	3	1	4	2
3	4	4	3	4							
TW1RK-2	1	28	3	3	4	3	3	4	2	5	3
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TW1RK-3	1	29	4	4	4	2	4	2	4	4	3
3	3	2	2	2	3	2	3	2	2	2	3
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XK9DJ-1	1	30	1	1	5	1	5	1	4	2	2
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XK9DJ-2	1	31	4	2	4	2	4	2	5	2	4
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4	4	2	2	3	3	2	4	3	2	4	2
4	2	4	3	4							
XK9DJ-3	1	32	3	4	4	4	2	3	2	4	1
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4	2	4	1	4							
OAQD7-1	2	33	3	3	4	3	3	3	4	4	3
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4	2	2	2	2	2	2	3	4	2	4	2
3	2	2	2	4							
OAQD7-2	2	34	3	3	4	4	4	2	5	5	1
4	1	4	1	4	2	4	2	1	3	4	4
1	4	1	5	4	5	3	4	4	4	2	5
3	2	4	2	2	2	3	4	2	2	4	2
4	3	4	2	5							
OAQD7-3	2	35	3	2	2	3	1	3	2	4	2
4	1	4	1	5	2	5	2	3	5	4	4
1	4	1	4	1	5	2	4	3	3	4	2
2	2	2	2	1	3	1	4	4	2	4	3
4	2	4	2	4							
4DH7W-1	2	36	3	3	4	4	3	4	2	5	2
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2	3	3	1	2	1	3	4	5	2	5	1
5	1	2	3	5							
4DH7W-2	2	37	3	3	3	3	3	3	3	3	3
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2	4	2	4	2	4	2	4	4	3	3	3
3	2	3	2	2	3	3	4	3	2	3	3
4	3	4	3	4							
4DH7W-3	2	38	3	3	4	2	4	2	3	4	2
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4	2	2	2	2	2	2	4	2	2	4	3
3	2	4	2	4							
4DH7W-4	2	39	1	5	2	3	1	4	1	5	1
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4DH7W-5	2	40	4	1	4	1	4	2	4	2	4
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3	2	1	2	1	2	2	4	3	3	4	3
3	2	4	3	4							

59HQR-1	2	41	1	4	4	4	2	3	1	5	2
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59HQR-2	2	42	3	4	5	3	4	4	3	3	3
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4	2	4	4	4							
59HQR-3	2	43	4	2	4	2	4	2	4	3	3
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3	2	4	2	3							
59HQR-4	2	44	3	3	4	3	3	3	4	3	3
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4	3	3	3	3							
59HQR-5	2	45	5	1	5	1	5	2	4	4	4
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59HQR-6	2	46	3	3	3	3	3	5	2	3	1
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3	4	4	2	3							
5M2N7-1	2	47	3	4	4	4	4	2	4	4	4
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5M2N7-2	2	48	3	2	4	4	4	2	4	5	1
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5M2N7-3	2	49	3	3	3	4	3	3	4	3	2
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9BW2Q-1	2	50	5	2	4	2	4	1	5	2	4
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9BW2Q-2	2	51	1	4	3	3	2	3	3	3	2
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9BW2Q-3	2	52	2	3	4	2	4	2	3	3	3
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4	2	4	3	3							
9BW2Q-4	2	53	3	3	4	2	4	2	3	4	4
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9BW2Q-5	2	54	3	2	5	1	4	1	3	4	4
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9BW2Q-6	2	55	4	2	4	2	4	2	5	2	4
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Q97Y2-1	2	56	3	4	2	4	2	3	2	5	4
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Q97Y2-2	2	57	4	2	4	3	2	2	2	3	4
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Q97Y2-3	2	58	4	2	5	1	5	1	5	3	4
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TW1RK-1	2	59	2	3	2	3	4	4	1	3	2
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TW1RK-2	2	60	3	3	4	3	3	4	2	5	3
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3	3	3	2	4							
TW1RK-3	2	61	4	3	4	2	4	2	4	4	3
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2	3	2	4	2	4	3	4	4	3	3	3

3	3	4	2	2	3	2	4	3	2	4	3
3	3	3	3	4							
XK9DJ-1	2	62	1	1	5	1	5	1	4	2	2
3	2	4	3	3	2	3	2	4	3	3	3
4	4	2	3	3	2	1	4	4	3	4	4
4	4	3	2	1	1	2	4	3	1	3	2
4	4	4	2	4							
XK9DJ-2	2	63	5	2	4	1	4	2	5	2	4
2	2	4	2	5	2	4	2	4	4	4	3
2	4	2	4	2	4	2	4	4	2	4	2
4	4	2	3	3	2	2	4	4	2	4	2
4	2	4	4	5							
XK9DJ-3	2	64	3	4	4	4	2	3	2	4	1
5	1	3	1	5	3	4	2	4	4	3	4
4	5	2	2	4	4	3	4	4	4	4	2
2	2	2	2	1	2	2	4	1	3	4	2
4	2	4	1	4							

APPENDIX IV. TEAM PERFORMANCE RAW DATA T1 AND T2

case	time	id	tc1	tc2	tc3	tc4	tc5	ti6	ti7	ti8	ti9	tp10
	tp11	tp12	tp13	tp14	ts15	ts16	ts17	ts18	ca19	ca20	ca21	ca22
	ca23	ca24	ca25	ca26	ca27	ca28	ca29	ca30	ca31	ca32	ca33	ca34
	ca35	ca36	ca37	ca38								
0AQD7-OW-GC-1			1	1	2	2	2	4	2	4	4	4
	4	4	4	4	4	4	4	4	4	3	3	4
	4	4	3	3	4	4	4	4	4	4	4	2
	2	4	4	3	4	4						
0AQD7-GC-OW-2			1	2	4	4	4	5	4	4	4	4
	4	4	4	4	4	5	5	5	5	5	4	5
	5	5	4	4	5	5	4	4	5	5	5	5
	5	5	5	5	5	5						
0AQD7-OW-OW-3			1	3	5	5	4	2	1	4	4	5
	5	4	5	5	4	4	5	5	5	5	5	5
	5	5	4	4	5	5	5	4	4	4	5	5
	5	5	5	5	5	5						
0AQD7-OW-GC-4			1	4	5	5	4	2	1	4	4	5
	5	4	5	5	4	4	5	5	5	5	5	5
	4	5	4	5	5	5	4	3	4	5	4	5
	5	4	5	5	4	5						
4DH7W-OW-OW-1			1	5	4	4	4	4	2	4	4	4
	4	4	4	4	4	4	4	4	5	5	4	5
	5	4	5	5	5	5	5	5	5	5	4	5
	4	5	5	5	5	5						
4DH7W-OW-OW-2			1	6	3	4	4	4	3	4	4	4
	4	4	4	4	5	5	5	5	5	5	4	4
	4	5	5	4	4	4	5	5	4	5	5	5
	5	4	5	5	5	5						
4DH7W-OW-OW-3			1	7	4	4	3	4	3	3	4	3
	4	5	4	4	4	4	4	5	5	4	3	3
	3	3	3	3	3	3	3	3	3	3	3	3
	3	3	3	3	3	3						
4DH7W-OW-GC-4			1	8	3	4	4	3	3	4	3	3
	3	3	3	3	3	3	3	3	3	3	4	4
	4	4	4	4	4	4	4	4	4	4	4	4
	4	4	4	4	4	4						
4DH7W-GC-OW-5			1	9	4	4	4	4	3	3	4	4
	4	3	3	3	4	4	5	4	5	5	5	5
	4	5	5	4	4	5	4	3	2	5	5	5
	5	5	5	4	5	5						
59HQR-OW-OW-1			1	10	4	4	4	3	1	3	4	4
	4	4	4	4	4	4	5	5	5	5	5	5
	5	5	4	5	5	5	5	5	5	5	5	5
	5	5	5	5	5	5						
59HQR-OW-GC-2			1	11	4	4	4	3	1	3	4	4
	4	4	4	4	4	4	5	5	5	5	5	5
	5	5	5	5	5	5	5	5	5	5	4	4
	4	4	5	5	5	5						
59HQR-OW-OW-3			1	12	4	4	4	4	4	3	3	3
	4	4	4	3	4	4	4	4	4	4	5	5

5	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5						
59HQR-OW-GC-4		1	13	4	4	4	4	4	3	3	3
4	4	4	3	4	4	4	4	4	4	5	5
5	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5						
59HQR-OW-OW-5		1	14	4	5	4	5	3	4	5	5
4	5	5	5	5	5	5	5	5	3	5	5
5	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5						
59HQR-GC-OW-6		1	15	4	4	4	3	3	4	5	4
4	3	4	3	4	4	5	4	5	5	5	5
4	5	5	4	5	5	4	3	4	5	5	5
5	5	5	4	5	5						
59HQR-OW-GC-7		1	16	3	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4	5	4
4	4	4	4	4	4	4	4	4	4	4	4
4	4	3	3	3	3						
59HQR-OW-GC-8		1	17	2	3	4	4	4	4	4	4
4	4	4	3	4	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4						
5M2N7-OW-GC-1		1	18	4	4	4	4	2	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
4	2	4	4	4	4						
5M2N7-GC-OW-2		1	19	4	5	5	5	4	4	5	5
5	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5						
5M2N7-OW-GC-3		1	20	4	5	5	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
3	3	4	4	4	4	4	4	3	4	3	4
4	3	4	4	4	4						
9BW2Q-OW-GC-1		1	21	4	4	5	5	4	5	4	4
4	4	4	4	4	4	4	5	4	4	4	5
4	4	5	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4						
9BW2Q-OW-GC-2		1	22	2	5	5	4	4	3	5	4
5	2	5	5	5	5	5	5	5	4	5	5
5	5	5	5	5	4	5	5	5	5	5	5
5	5	5	5	5	5						
9BW2Q-OW-GC-3		1	23	4	4	4	5	5	4	5	4
5	4	4	4	3	4	4	5	3	4	5	5
4	4	5	4	3	4	4	4	3	3	3	4
3	4	4	4	4	3						
9BW2Q-GC-OW-4		1	24	4	4	4	4	4	4	4	4
4	4	2	3	3	3	4	4	4	4	4	4
4	4	5	5	5	5	4	4	4	4	5	4
4	4	5	5	5	5						
9BW2Q-OW-OW-5		1	25	2	4	4	3	3	2	5	4
4	4	4	4	4	4	4	5	5	4	5	5

5	5	5	5	5	4	5	5	5	5	5	5
5	5	5	5	5	5						
9BW2Q-OW-GC-6		1	26	2	4	4	3	3	2	5	4
4	4	4	4	4	4	4	5	5	4	4	4
3	3	4	4	4	3	4	4	4	4	3	3
3	3	4	3	3	3						
9BW2Q-OW-GC-7		1	27	2	2	3	4	3	4	4	2
5	2	4	2	4	4	3	4	2	3	3	3
3	3	3	4	4	4	3	3	3	3	3	3
3	3	3	3	3	3						
Q97Y2-OW-OW-1		1	28	4	4	4	3	3	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
4	4	3	4	3	3	4	3	3	3	4	4
4	4	3	3	3	3						
Q97Y2-OW-GC-2		1	29	4	4	4	3	3	4	4	4
4	4	4	4	4	4	4	4	4	4	4	3
3	3	3	4	3	3	3	4	3	3	4	3
3	3	3	4	4	3						
Q97Y2-OW-GC-3		1	30	5	5	3	3	4	4	4	4
3	3	4	3	2	4	4	3	4	3	5	5
5	4	5	4	5	4	5	4	4	5	5	4
4	5	4	5	5	5						
Q97Y2-GC-OW-4		1	31	4	5	4	5	2	4	4	3
5	4	3	3	4	4	5	4	5	5	4	5
4	5	4	3	3	4	4	4	3	5	5	5
4	5	4	5	5	5						
TW1RK-OW-OW-1		1	32	5	4	5	4	4	4	4	1
4	5	5	3	4	4	5	4	4	4	4	4
2	3	5	2	4	4	4	4	5	5	5	5
4	4	4	2	4	4						
TW1RK-OW-GC-2		1	33	5	4	5	4	4	4	4	1
4	5	5	3	4	4	5	4	4	4	5	5
4	4	5	4	5	5	5	5	5	4	4	4
4	5	5	4	5	5						
TW1RK-GC-OW-3		1	34	4	4	5	5	1	4	4	4
5	5	4	4	4	4	4	5	4	4	4	4
4	4	5	4	5	5	4	4	4	4	4	3
4	4	4	4	5	5						
TW1RK-GC-OW-4		1	35	4	4	4	3	4	4	5	5
4	4	4	4	4	4	5	4	4	4	5	5
4	5	5	5	5	5	4	4	5	5	5	5
5	5	5	4	5	5						
XK9DJ-OW-OW-1		1	36	4	3	4	5	3	4	3	3
4	3	3	3	4	4	3	5	4	3	4	4
4	5	5	4	5	5	4	4	4	3	4	4
4	4	5	4	4	4						
XK9DJ-OW-GC-2		1	37	4	3	4	5	3	4	3	3
4	3	3	3	4	4	3	5	4	3	3	5
4	3	4	4	4	4	4	4	3	4	4	3
3	4	5	3	4	3						
XK9DJ-OW-OW-3		1	38	4	5	5	4	4	5	5	5
5	3	3	3	5	4	5	5	5	5	5	5

5	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5						
XK9DJ-GC-OW-4		1	39	5	5	5	5	4	5	5	4
4	4	4	3	4	5	5	5	5	5	5	5
5	5	4	4	4	5	5	4	3	5	5	5
5	5	5	5	5	5						
0AQD7-OW-GC-1		2	40	2	2	2	4	2	4	4	4
4	4	4	4	4	4	3	4	4	3	3	4
4	4	3	3	4	4	4	4	4	4	4	2
2	4	4	3	4	4						
0AQD7-GC-OW-2		2	41	4	4	4	5	4	4	4	4
4	4	4	3	4	4	5	5	5	5	4	5
4	5	4	4	5	5	4	4	5	5	5	5
5	5	5	5	5	5						
0AQD7-OW-OW-3		2	42	5	5	3	3	5	4	4	5
5	4	5	5	4	4	5	5	5	5	5	5
5	5	4	4	5	5	4	4	4	4	5	5
5	5	5	5	5	5						
0AQD7-OW-GC-4		2	43	5	5	3	3	5	4	4	5
5	4	5	5	4	4	5	5	5	5	3	4
4	4	3	3	4	4	4	4	4	4	4	2
2	4	4	3	4	4						
4DH7W-OW-OW-1		2	44	4	4	4	5	4	4	4	4
4	4	4	4	4	4	4	4	4	5	4	5
5	4	5	5	5	5	5	5	4	5	4	5
4	5	5	5	5	5						
4DH7W-OW-OW-2		2	45	4	4	4	3	4	4	5	4
4	4	4	4	4	4	4	4	4	4	5	4
4	5	5	4	4	4	5	4	4	5	5	4
5	5	4	4	5	4						
4DH7W-OW-OW-3		2	46	4	4	4	4	2	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4						
4DH7W-OW-GC-4		2	47	3	4	4	3	3	4	3	3
3	3	3	3	3	3	3	3	3	3	3	4
3	3	4	3	3	4	3	3	3	3	3	3
3	3	3	3	3	3						
4DH7W-GC-OW-5		2	48	4	4	4	4	3	3	4	4
4	3	3	3	4	4	5	4	5	5	5	5
4	5	5	4	4	5	4	3	2	5	5	5
5	5	5	4	5	5						
59HQR-OW-OW-1		2	49	4	4	3	3	5	3	4	4
4	4	4	4	4	4	5	5	5	5	5	5
5	5	4	4	5	5	5	5	4	5	5	5
5	5	5	5	5	5						
59HQR-OW-GC-2		2	50	4	4	3	3	5	3	4	4
4	4	4	4	4	4	5	5	5	5	5	5
5	5	5	5	4	5	4	5	5	5	4	4
4	4	5	5	5	5						
59HQR-OW-OW-3		2	51	4	4	5	4	2	3	3	3
4	4	4	3	4	4	4	4	4	4	5	5

5	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5						
59HQR-OW-GC-4		2	52	4	4	5	4	2	3	3	3
4	4	4	3	4	4	4	4	4	4	4	5
4	5	5	5	5	5	5	4	5	5	5	5
5	5	5	5	5	5						
59HQR-OW-OW-5		2	53	4	5	4	3	3	4	5	5
4	5	5	5	5	4	3	5	5	5	5	4
4	4	5	4	4	5	5	5	5	4	5	4
5	5	5	5	4	4						
59HQR-GC-OW-6		2	54	4	4	4	4	3	4	5	4
4	3	4	3	4	4	5	3	4	5	5	5
5	5	5	4	5	5	4	3	4	5	5	5
5	5	5	5	5	5						
59HQR-OW-GC-7		2	55	3	4	4	5	3	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
4	4	3	4	4	4	4	4	4	4	4	4
4	4	3	3	3	3						
59HQR-OW-GC-8		2	56	2	3	4	4	4	4	4	4
4	4	4	3	4	4	4	4	4	4	4	4
4	4	4	5	4	4	4	4	4	4	4	5
4	4	4	4	4	4						
5M2N7-OW-GC-1		2	57	4	4	4	2	4	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4						
5M2N7-GC-OW-2		2	58	4	5	5	5	2	4	5	5
5	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5						
5M2N7-OW-GC-3		2	59	4	5	5	4	2	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
3	3	4	4	4	4	4	4	3	4	3	4
4	3	4	4	4	4						
9BW2Q-OW-GC-1		2	60	4	4	4	5	4	4	4	3
4	4	4	4	4	4	4	4	4	4	4	5
4	4	4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4						
9BW2Q-OW-GC-2		2	61	2	5	5	4	4	3	5	4
5	2	5	5	5	5	5	5	5	4	5	5
5	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5						
9BW2Q-OW-GC-3		2	62	4	4	4	5	1	4	5	4
5	4	4	4	3	4	4	5	3	4	5	5
4	4	5	4	3	4	4	4	3	3	3	4
3	4	4	4	4	3						
9BW2Q-GC-OW-4		2	63	4	4	4	3	3	4	4	4
3	4	4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
4	4	4	4	4	4						
9BW2Q-OW-OW-5		2	64	2	4	4	3	3	2	5	4
4	4	4	4	4	4	4	5	5	4	5	5

5	5	5	5	5	4	5	5	5	5	5	5
5	5	5	5	5	5						
9BW2Q-OW-GC-6		2	65	2	4	4	3	3	2	5	4
4	4	4	4	4	4	4	5	5	4	4	4
3	3	4	4	4	3	4	4	3	4	4	3
4	3	4	3	3	3						
9BW2Q-OW-GC-7		2	66	2	2	3	4	3	4	4	2
5	2	4	2	4	4	3	4	2	3	3	3
3	3	3	4	4	4	3	3	3	3	3	3
3	3	3	3	3	3						
Q97Y2-OW-OW-1		2	67	4	4	4	3	3	4	4	4
4	4	4	4	4	4	4	4	4	4	4	4
4	4	3	4	3	3	4	3	3	3	4	4
4	4	3	3	3	3						
Q97Y2-OW-GC-2		2	68	4	4	4	3	3	4	4	4
4	4	4	4	4	4	4	4	4	4	4	3
3	3	3	4	3	3	3	4	3	3	4	3
3	3	3	4	4	3						
Q97Y2-OW-GC-3		2	69	5	5	3	4	2	4	4	4
3	3	4	3	2	4	4	3	4	3	5	5
5	4	5	4	5	4	5	4	4	5	5	4
4	5	4	5	5	5						
Q97Y2-GC-OW-4		2	70	4	4	4	5	2	4	4	3
5	4	3	3	4	4	5	4	5	5	4	5
4	5	4	3	3	4	4	4	3	5	5	5
4	5	4	5	5	5						
TW1RK-OW-OW-1		2	71	5	4	4	4	3	4	4	2
4	5	5	3	4	4	5	5	4	4	4	4
2	3	5	2	4	4	4	4	4	5	5	5
4	4	4	2	4	4						
TW1RK-OW-GC-2		2	72	5	4	4	4	3	4	4	2
4	5	5	3	4	4	5	5	4	4	5	5
4	4	5	4	5	5	5	5	5	4	4	4
4	5	4	4	5	5						
TW1RK-GC-OW-3		2	73	4	4	5	5	2	4	4	4
5	5	4	4	4	4	4	5	4	4	4	4
4	5	5	4	5	5	4	4	4	4	4	3
4	4	4	4	5	5						
TW1RK-GC-OW-4		2	74	4	4	4	3	3	4	4	5
4	4	4	4	4	4	5	4	4	4	5	5
4	5	5	5	5	5	4	4	5	5	5	5
5	5	5	4	5	5						
XK9DJ-OW-OW-1		2	75	4	3	4	4	3	4	3	3
4	3	3	3	4	4	3	4	4	3	4	4
4	5	5	4	5	5	4	4	4	3	4	4
4	4	5	4	4	4						
XK9DJ-OW-GC-2		2	76	4	3	4	4	3	4	3	3
4	3	3	3	4	4	3	4	4	3	3	5
4	3	4	4	4	4	4	4	3	4	4	3
3	4	5	3	4	3						
XK9DJ-OW-OW-3		2	77	4	5	5	4	2	5	5	5
5	3	3	3	5	5	5	5	5	5	5	5

5	5	5	5	5	5	5	5	5	5	5	5
5	5	5	5	5	5						
XK9DJ-GC-OW-4		2	78	5	4	4	5	2	5	5	4
4	4	4	3	4	5	5	5	5	5	5	5
5	5	4	4	4	5	5	4	3	5	5	5
5	5	5	5	5	5						

APPENDIX V. DESCRIPTIVE STATISTICS OF THE PSFQ AVERAGE SCORES

items	**vars**	**n**	**mean**	**sd**	**median**	**trimmed**	**mad**	**min**	**max**	**range**	**skew**	**kurtosis**	**se**
e1	1	32	3.06	1.05	3	3.12	0.37	1	5	4	-0.47	-0.23	0.18
e2	2	32	2.8	1.04	3	2.83	1.48	1	5	4	-0.03	-0.98	0.18
e3	3	32	3.81	0.86	4	3.88	0	2	5	3	-0.83	0.12	0.15
e4	4	32	2.66	1.02	3	2.69	1.48	1	4	3	-0.24	-1.15	0.18
e5	5	32	3.41	1.08	4	3.46	1.11	1	5	4	-0.64	-0.5	0.19
e6	6	32	2.59	0.94	2.5	2.6	0.74	1	4.5	3.5	0.16	-0.87	0.17
e7	7	32	3.19	1.22	3	3.21	1.48	1	5	4	-0.17	-1.22	0.22
e8	8	32	3.52	1	3.25	3.52	1.11	2	5	3	0.05	-1.2	0.18
e9	9	32	2.83	1.03	3	2.9	1.48	1	4	3	-0.35	-1.13	0.18
e10	10	32	3.12	1.15	3	3.13	1.48	1	5	4	0.01	-0.96	0.2
a1	11	32	1.88	0.88	2	1.77	1.48	1	4	3	0.78	-0.16	0.16
a2	12	32	3.66	0.75	4	3.71	0	2	5	3	-0.69	0.14	0.13
a3	13	32	1.77	0.79	1.75	1.71	1.11	1	3	2	0.39	-1.45	0.14
a4	14	32	3.73	0.97	4	3.79	0.74	2	5	3	-0.5	-0.76	0.17
a5	15	32	2.47	0.74	2.25	2.42	0.37	1	4	3	0.34	-0.16	0.13
a6	16	32	3.62	0.79	4	3.69	0	2	5	3	-0.82	-0.28	0.14
a7	17	32	2.36	0.69	2	2.33	0	1	4	3	0.5	0.23	0.12
a8	18	32	3.66	0.87	4	3.73	0	1	5	4	-1.09	1.31	0.15
a9	19	32	3.41	0.78	3.5	3.42	0.74	2	5	3	-0.1	-0.41	0.14
a10	20	32	3.55	0.68	3.5	3.56	0.74	2	5	3	-0.16	0.24	0.12
c1	21	32	3.73	0.63	4	3.73	0	2	5	3	-0.44	0.26	0.11
c2	22	32	2.25	0.98	2	2.19	1.11	1	4	3	0.49	-0.75	0.17
c3	23	32	4.03	0.57	4	4.04	0	3	5	2	0.27	-0.28	0.1
c4	24	32	1.88	0.7	2	1.81	0	1	4	3	0.64	0.89	0.12
c5	25	32	3.64	0.84	4	3.65	1.11	2	5	3	-0.11	-0.8	0.15
c6	26	32	2.38	1.04	2	2.35	1.48	1	4	3	0.26	-1.15	0.18
c7	27	32	4.19	0.74	4	4.29	0	2	5	3	-1.28	2.27	0.13
c8	28	32	2.16	0.77	2	2.15	0.74	1	4	3	0.11	-0.6	0.14
c9	29	32	3.98	0.67	4	4.02	0	2	5	3	-0.66	0.94	0.12
c10	30	32	3.88	0.64	4	3.9	0	2	5	3	-0.82	1.36	0.11
n1	31	32	2.64	0.9	2.5	2.6	0.74	1	5	4	0.52	-0.06	0.16
n2	32	32	3.48	0.87	4	3.5	0.74	2	5	3	-0.39	-0.87	0.15
n3	33	32	3.08	1.02	3	3.13	1.48	1	5	4	-0.34	-0.94	0.18
n4	34	32	3.17	0.81	3	3.17	1.48	2	5	3	0.07	-0.97	0.14
n5	35	32	2.52	0.91	2	2.52	0.74	1	4	3	0.36	-0.87	0.16
n6	36	32	2.22	0.83	2	2.19	1.11	1	4	3	0.21	-0.61	0.15
n7	37	32	2.14	0.66	2	2.13	0	1	4	3	0.38	0.51	0.12
n8	38	32	1.91	0.8	2	1.85	1.11	1	4	3	0.44	-0.46	0.14
n9	39	32	2.06	0.79	2	2.04	1.11	1	4	3	0.23	-0.62	0.14
n10	40	32	2.03	0.67	2	2	0	1	4	3	0.43	0.79	0.12
o1	41	32	3.86	0.57	4	3.88	0	2	5	3	-0.97	2.2	0.1
o2	42	32	3.2	0.98	3	3.17	1.48	1	5	4	0.04	-0.55	0.17
o3	43	32	2.2	0.59	2	2.25	0.37	1	3	2	-0.23	-0.53	0.1
o4	44	32	3.81	0.7	4	3.87	0	2	5	3	-0.88	1.02	0.12
o5	45	32	2.39	0.75	2	2.38	0.74	1	5	4	0.98	2.59	0.13
o6	46	32	3.67	0.53	4	3.67	0	3	5	2	-0.07	-0.84	0.09
o7	47	32	2.31	0.85	2	2.27	0.74	1	4	3	0.54	-0.25	0.15
o8	48	32	3.75	0.65	4	3.81	0	2	5	3	-0.95	1.44	0.11
o9	49	32	2.7	0.71	3	2.67	0.74	1	4	3	-0.05	-0.44	0.12
o10	50	32	3.92	0.76	4	3.98	0.37	2	5	3	-0.75	0.44	0.13

APPENDIX VI. DESCRIPTIVE STATISTICS OF THE TPQ AVERAGE SCORES

items	vars	n	mean	sd	medi	trim	mad	min	max	rang	skew	kurt	se
tc1	1	39	3.78	0.89	4	3.83	0	2	5	3	-0.85	-0.01	0.14
tc2	2	39	4.05	0.71	4	4.12	0	2	5	3	-0.97	1.49	0.11
tc3	3	39	4.04	0.60	4	4.08	0	2	5	3	-0.77	1.85	0.10
tc4	4	39	3.87	0.76	4	3.88	0.74	2.5	5	2.5	-0.02	-1.12	0.12
tc5	5	39	3.08	0.51	3	3.11	0	1.5	4	2.5	-0.59	1.69	0.08
ti6	6	39	3.79	0.63	4	3.83	0	2	5	3	-1.10	1.64	0.10
ti7	7	39	4.13	0.60	4	4.15	0	3	5	2	-0.14	-0.43	0.10
ti8	8	39	3.79	0.85	4	3.88	0	1.5	5	3.5	-0.94	1.00	0.14
ti9	9	39	4.17	0.52	4	4.18	0	3	5	2	0.30	-0.04	0.08
tp10	10	39	3.86	0.72	4	3.89	0	2	5	3	-0.67	0.55	0.11
tp11	11	39	4.00	0.61	4	4	0	3	5	2	0.00	-0.36	0.10
tp12	12	39	3.69	0.72	4	3.67	1.48	2	5	3	0.15	-0.53	0.12
tp13	13	39	4.00	0.53	4	4.03	0	2	5	3	-1.06	4.43	0.08
tp14	14	39	4.09	0.36	4	4.06	0	3	5	2	0.56	2.63	0.06
ts15	15	39	4.28	0.66	4	4.33	0.74	3	5	2	-0.34	-0.9	0.11
ts16	16	39	4.38	0.57	4.5	4.44	0.74	3	5	2	-0.5	-0.45	0.09
ts17	17	39	4.31	0.67	4	4.39	0.74	2	5	3	-1.05	1.65	0.11
ts18	18	39	4.17	0.67	4	4.2	0	3	5	2	-0.22	-0.87	0.11
ca19	19	39	4.35	0.64	4	4.41	0.74	3	5	2	-0.46	-0.86	0.10
ca20	20	39	4.50	0.61	5	4.58	0	3	5	2	-0.77	-0.50	0.10
ca21	21	39	4.15	0.72	4	4.21	0.74	2	5	3	-0.69	0.35	0.11
ca22	22	39	4.29	0.74	4.5	4.35	0.74	3	5	2	-0.53	-1.13	0.12
ca23	23	39	4.37	0.70	4.5	4.44	0.74	3	5	2	-0.60	-1.01	0.11
ca24	24	39	4.15	0.64	4	4.21	0	2	5	3	-0.79	1.60	0.10
ca25	25	39	4.33	0.67	4.5	4.39	0.74	3	5	2	-0.54	-0.87	0.11
ca26	26	39	4.38	0.63	4.5	4.45	0.74	3	5	2	-0.56	-0.70	0.10
ca27	27	39	4.28	0.58	4	4.32	0	3	5	2	-0.10	-0.83	0.09
ca28	28	39	4.14	0.62	4	4.17	0	3	5	2	-0.04	-0.74	0.10
ca29	29	39	4.03	0.80	4	4.06	1.48	2	5	3	-0.34	-0.78	0.13
ca30	30	39	4.33	0.72	4.5	4.39	0.74	3	5	2	-0.56	-1.04	0.12
ca31	31	39	4.36	0.67	4	4.42	1.48	3	5	2	-0.46	-1.05	0.11
ca32	32	39	4.23	0.8	4	4.3	1.48	2	5	3	-0.72	-0.35	0.13
ca33	33	39	4.18	0.77	4	4.24	1.48	2	5	3	-0.55	-0.28	0.12
ca34	34	39	4.32	0.72	4	4.38	1.48	3	5	2	-0.51	-1.09	0.12
ca35	35	39	4.38	0.68	4.5	4.45	0.74	3	5	2	-0.68	-0.79	0.11
ca36	36	39	4.19	0.81	4	4.26	1.48	2	5	3	-0.65	-0.47	0.13
ca37	37	39	4.41	0.70	5	4.48	0	3	5	2	-0.71	-0.83	0.11
ca38	38	39	4.33	0.78	4.5	4.39	0.74	3	5	2	-0.67	-1.14	0.13

APPENDIX VII. PERSONALITY RAW SCORES FROM SCOREITEM AVERAGE SCORES

n	Code	Individual					Team				
		EX	AG	CO	NE	OP	EX	AG	CO	NE	OP
1	0AQD7-OW-GC-1	3.00	3.70	3.50	3.90	3.40	2.66	4.09	4.04	3.60	3.61
2	0AQD7-GC-OW-2	2.95	3.85	4.05	2.90	3.65					
3	0AQD7-OW-OW-3	2.35	4.40	4.30	3.80	3.70					
4	0AQD7-OW-GC-4	2.35	4.40	4.30	3.80	3.70					
5	4DH7W-OW-OW-1	2.25	4.25	4.90	3.10	4.30	2.78	3.65	3.78	3.71	3.45
6	4DH7W-OW-OW-2	3.00	3.40	3.95	3.25	3.55					
7	4DH7W-OW-OW-3	3.10	3.50	3.40	3.40	3.20					
8	4DH7W-OW-GC-4	1.35	3.10	3.65	5.00	2.70					
9	4DH7W-GC-OW-5	4.20	4.00	3.00	3.80	3.50					
10	59HQR-OW-OW-1	2.10	4.25	4.70	3.25	4.15	3.14	3.93	4.20	3.89	3.96
11	59HQR-OW-GC-2	2.10	4.25	4.70	3.25	4.15					
12	59HQR-OW-OW-3	3.15	4.20	3.85	4.00	4.20					
13	59HQR-OW-GC-4	3.15	4.20	3.85	4.00	4.20					
14	59HQR-OW-OW-5	3.20	3.20	4.10	3.60	3.50					
15	59HQR-GC-OW-6	4.40	4.70	4.70	4.75	4.60					
16	59HQR-OW-GC-7	3.45	2.55	4.00	4.35	3.45					
17	59HQR-OW-GC-8	3.60	4.10	3.70	3.90	3.40					
18	5M2N7-OW-GC-1	3.15	3.20	3.60	4.00	3.50	2.98	3.63	3.83	3.70	3.50
19	5M2N7-GC-OW-2	2.90	4.30	4.00	3.00	3.30					
20	5M2N7-OW-GC-3	2.90	3.40	3.90	4.10	3.70					
21	9BW2Q-OW-GC-1	4.20	4.25	3.35	3.60	3.90	3.56	3.81	4.15	3.24	3.54
22	9BW2Q-OW-GC-2	2.40	4.10	3.90	3.00	4.10					
23	9BW2Q-OW-GC-3	3.30	4.00	4.40	3.70	3.65					
24	9BW2Q-GC-OW-4	3.45	3.90	3.85	3.15	3.05					
25	9BW2Q-OW-OW-5	3.85	3.40	4.80	2.90	3.30					
26	9BW2Q-OW-GC-6	3.85	3.40	4.80	2.90	3.30					
27	9BW2Q-OW-GC-7	3.90	3.60	3.95	3.45	3.50					
28	Q97Y2-OW-OW-1	2.40	2.80	3.40	3.50	3.90	3.20	3.25	3.85	3.58	3.86
29	Q97Y2-OW-GC-2	2.40	2.80	3.40	3.50	3.90					
30	Q97Y2-OW-GC-3	3.40	3.10	4.00	3.10	3.25					
31	Q97Y2-GC-OW-4	4.60	4.30	4.60	4.20	4.40					
32	TW1RK-OW-OW-1	2.25	3.55	3.10	3.60	3.50	2.64	3.33	3.30	3.35	3.29
33	TW1RK-OW-GC-2	2.25	3.55	3.10	3.60	3.50					
34	TW1RK-GC-OW-3	2.60	3.70	3.30	3.00	2.80					
35	TW1RK-GC-OW-4	3.45	2.50	3.70	3.20	3.35					
36	XK9DJ-OW-OW-1	4.20	4.10	3.75	3.60	3.95	3.63	3.93	3.56	3.63	3.68
37	XK9DJ-OW-GC-2	4.20	4.10	3.75	3.60	3.95					
38	XK9DJ-OW-OW-3	2.20	4.00	3.40	3.70	3.30					
39	XK9DJ-GC-OW-4	3.90	3.50	3.35	3.60	3.50					

APPENDIX VIII. PERSONALITY PERCENTILE SCORES AVERAGE SCORES

n	Case	EX	AG	CO	NE	OP
1	0AQD7-OW-GC-1	0.42	0.45	0.26	0.21	0.26
2	0AQD7-GC-OW-2	0.39	0.50	0.71	0.95	0.55
3	0AQD7-OW-OW-3	0.18	0.95	0.76	0.26	0.61
4	0AQD7-OW-GC-4	0.18	0.95	0.76	0.26	0.61
5	4DH7W-OW-OW-1	0.11	0.79	1.00	0.82	0.95
6	4DH7W-OW-OW-2	0.42	0.21	0.61	0.68	0.53
7	4DH7W-OW-OW-3	0.47	0.32	0.16	0.66	0.08
8	4DH7W-OW-GC-4	0.00	0.11	0.32	0.00	0.00
9	4DH7W-GC-OW-5	0.95	0.55	0.00	0.26	0.34
10	59HQR-OW-OW-1	0.03	0.79	0.87	0.68	0.84
11	59HQR-OW-GC-2	0.03	0.79	0.87	0.68	0.84
12	59HQR-OW-OW-3	0.50	0.74	0.45	0.13	0.89
13	59HQR-OW-GC-4	0.50	0.74	0.45	0.13	0.89
14	59HQR-OW-OW-5	0.58	0.16	0.74	0.39	0.34
15	59HQR-GC-OW-6	0.97	1.00	0.87	0.03	1.00
16	59HQR-OW-GC-7	0.66	0.03	0.63	0.05	0.32
17	59HQR-OW-GC-8	0.74	0.63	0.34	0.21	0.26
18	5M2N7-OW-GC-1	0.50	0.16	0.29	0.13	0.34
19	5M2N7-GC-OW-2	0.34	0.89	0.63	0.87	0.13
20	5M2N7-OW-GC-3	0.34	0.21	0.53	0.11	0.61
21	9BW2Q-OW-GC-1	0.87	0.79	0.11	0.39	0.68
22	9BW2Q-OW-GC-2	0.24	0.63	0.53	0.87	0.82
23	9BW2Q-OW-GC-3	0.61	0.55	0.82	0.34	0.55
24	9BW2Q-GC-OW-4	0.66	0.53	0.45	0.79	0.05
25	9BW2Q-OW-OW-5	0.76	0.21	0.95	0.95	0.13
26	9BW2Q-OW-GC-6	0.76	0.21	0.95	0.95	0.13
27	9BW2Q-OW-GC-7	0.82	0.42	0.58	0.63	0.34
28	Q97Y2-OW-OW-1	0.24	0.05	0.16	0.58	0.68
29	Q97Y2-OW-GC-2	0.24	0.05	0.16	0.58	0.68
30	Q97Y2-OW-GC-3	0.63	0.11	0.63	0.82	0.11
31	Q97Y2-GC-OW-4	1.00	0.89	0.84	0.08	0.97
32	TW1RK-OW-OW-1	0.11	0.37	0.03	0.39	0.34
33	TW1RK-OW-GC-2	0.11	0.37	0.03	0.39	0.34
34	TW1RK-GC-OW-3	0.32	0.45	0.08	0.87	0.03
35	TW1RK-GC-OW-4	0.66	0.00	0.34	0.76	0.24
36	XK9DJ-OW-OW-1	0.87	0.63	0.39	0.39	0.76
37	XK9DJ-OW-GC-2	0.87	0.63	0.39	0.39	0.76
38	XK9DJ-OW-OW-3	0.08	0.55	0.16	0.34	0.13
39	XK9DJ-GC-OW-4	0.82	0.32	0.11	0.39	0.34

APPENDIX IX. TEAM PERFORMANCE RAW SCORES FROM SCOREITEM AVERAGE SCORES

n	Code	Team Member Evaluated	Individual								
			TCP	TIS	TPO	TSV	TMS	SVGC	CRP	CIS	TRP
1	0AQD7-OW-GC-1	GC	2.40	4.00	4.00	3.63	3.75	3.50	4.00	3.00	3.75
2	0AQD7-GC-OW-2	Owner	4.20	4.00	4.00	5.00	4.63	4.50	4.50	5.00	5.00
3	0AQD7-OW-OW-3	Owner	3.80	4.50	4.40	5.00	5.00	4.50	4.13	5.00	5.00
4	0AQD7-OW-GC-4	GC	3.80	4.50	4.40	5.00	4.25	4.13	4.00	3.75	4.25
5	4DH7W-OW-OW-1	Owner	3.90	4.00	4.00	4.38	4.50	5.00	4.88	4.50	5.00
6	4DH7W-OW-OW-2	Owner	3.70	4.13	4.20	4.50	4.38	4.25	4.63	4.75	4.63
7	4DH7W-OW-OW-3	Owner	3.60	3.75	4.10	4.25	3.50	3.50	3.50	3.50	3.50
8	4DH7W-OW-GC-4	GC	3.40	3.25	3.00	3.00	3.63	3.75	3.50	3.50	3.50
9	4DH7W-GC-OW-5	Owner	3.80	3.75	3.40	4.75	4.75	4.50	3.50	5.00	4.75
10	59HQR-OW-OW-1	Owner	3.50	3.75	4.00	5.00	5.00	4.63	4.88	5.00	5.00
11	59HQR-OW-GC-2	GC	3.50	3.75	4.00	5.00	5.00	4.88	4.88	4.00	5.00
12	59HQR-OW-OW-3	Owner	3.90	3.25	3.80	4.00	5.00	5.00	5.00	5.00	5.00
13	59HQR-OW-GC-4	GC	3.90	3.25	3.80	4.00	4.75	5.00	4.88	5.00	5.00
14	59HQR-OW-OW-5	Owner	4.00	4.50	4.90	4.50	4.63	4.75	4.88	4.88	4.75
15	59HQR-GC-OW-6	Owner	3.70	4.25	3.60	4.50	4.88	4.75	4.00	5.00	4.88
16	59HQR-OW-GC-7	GC	3.80	4.00	4.00	4.00	4.13	3.88	4.00	4.00	3.00
17	59HQR-OW-GC-8	GC	3.40	4.00	3.80	4.00	4.00	4.13	4.00	4.13	4.00
18	5M2N7-OW-GC-1	GC	3.60	4.00	4.00	4.00	4.00	4.00	4.00	3.75	4.00
19	5M2N7-GC-OW-2	Owner	4.40	4.75	5.00	5.00	5.00	5.00	5.00	5.00	5.00
20	5M2N7-OW-GC-3	GC	4.20	4.00	4.00	4.00	3.50	4.00	3.75	3.50	4.00
21	9BW2Q-OW-GC-1	GC	4.30	4.00	4.00	4.13	4.25	4.13	4.00	4.00	4.00
22	9BW2Q-OW-GC-2	GC	4.00	4.25	4.40	4.75	5.00	4.88	5.00	5.00	5.00
23	9BW2Q-OW-GC-3	GC	4.00	4.50	3.80	4.00	4.50	4.00	3.50	3.50	3.75
24	9BW2Q-GC-OW-4	Owner	3.80	3.88	3.50	4.00	4.00	4.50	4.00	4.13	4.50
25	9BW2Q-OW-OW-5	Owner	3.20	3.75	4.00	4.50	5.00	4.75	5.00	5.00	5.00
26	9BW2Q-OW-GC-6	GC	3.20	3.75	4.00	4.50	3.50	3.75	3.88	3.25	3.25
27	9BW2Q-OW-GC-7	GC	2.80	3.75	3.20	3.00	3.00	3.75	3.00	3.00	3.00
28	Q97Y2-OW-OW-1	Owner	3.60	4.00	4.00	4.00	4.00	3.25	3.25	4.00	3.00
29	Q97Y2-OW-GC-2	GC	3.60	4.00	4.00	4.00	3.25	3.25	3.25	3.25	3.50
30	Q97Y2-OW-GC-3	GC	3.90	3.75	3.20	3.50	4.75	4.50	4.50	4.50	4.75
31	Q97Y2-GC-OW-4	Owner	3.90	4.00	3.60	4.75	4.50	3.50	4.00	4.75	4.75
32	TW1RK-OW-OW-1	Owner	4.20	3.38	4.20	4.38	3.25	3.75	4.38	4.50	3.50
33	TW1RK-OW-GC-2	GC	4.20	3.38	4.20	4.38	4.50	4.75	4.75	4.25	4.63
34	TW1RK-GC-OW-3	Owner	3.90	4.25	4.20	4.25	4.13	4.75	4.00	3.75	4.50
35	TW1RK-GC-OW-4	Owner	3.70	4.38	4.00	4.25	4.75	5.00	4.50	5.00	4.75
36	XK9DJ-OW-OW-1	Owner	3.70	3.50	3.40	3.63	4.25	4.75	3.75	4.00	4.25
37	XK9DJ-OW-GC-2	GC	3.70	3.50	3.40	3.63	3.75	4.00	3.75	3.50	3.75

38	XK9DJ-OW-OW-3	Owner	4.20	5.00	3.70	5.00	5.00	5.00	5.00	5.00	5.00
39	XK9DJ-GC-OW-4	Owner	4.40	4.50	4.00	5.00	5.00	4.25	4.25	5.00	5.00

n	**Case**	**Team**								
		TCP	**TIS**	**TPO**	**TSV**	**TMS**	**SVGC**	**CRP**	**CIS**	**TRP**
1	0AQD7	3.55	4.25	4.20	4.66	4.41	4.16	4.16	4.19	4.50
2	4DH7W	3.68	3.78	3.74	4.18	4.15	4.20	4.00	4.25	4.28
3	59HQR	3.71	3.84	3.99	4.38	4.67	4.63	4.56	4.63	4.58
4	5M2N7	4.07	4.25	4.33	4.33	4.17	4.33	4.25	4.08	4.33
5	9BW2Q	3.61	3.98	3.84	4.13	4.18	4.25	4.05	3.98	4.07
6	Q97Y2	3.75	3.94	3.70	4.06	4.13	3.63	3.75	4.13	4.00
7	TW1RK	4.00	3.84	4.15	4.31	4.16	4.56	4.41	4.38	4.34
8	XK9DJ	4.00	4.13	3.63	4.31	4.50	4.50	4.19	4.38	4.50

APPENDIX X. TEAM PERFORMANCE PERCENTILE SCORES AVERAGE SCORES

n	Case	TCP	TIS	TPO	TSV	TMS	SVGC	CRP	CIS	TRP	Ind. TP
1	0AQD7-OW-GC-1	0.00	0.42	0.37	0.08	0.18	0.05	0.29	0.00	0.21	0.16
2	0AQD7-GC-OW-2	0.82	0.42	0.37	0.82	0.61	0.50	0.63	0.68	0.71	0.68
3	0AQD7-OW-OW-3	0.45	0.84	0.89	0.82	0.79	0.50	0.55	0.68	0.71	0.68
4	0AQD7-OW-GC-4	0.45	0.84	0.89	0.82	0.39	0.37	0.29	0.24	0.39	0.37
5	4DH7W-OW-OW-1	0.71	0.42	0.37	0.53	0.50	0.87	0.76	0.53	0.71	0.76
6	4DH7W-OW-OW-2	0.32	0.71	0.79	0.61	0.47	0.45	0.71	0.61	0.50	0.55
7	4DH7W-OW-OW-3	0.21	0.18	0.76	0.45	0.08	0.05	0.08	0.11	0.11	0.05
8	4DH7W-OW-GC-4	0.11	0.00	0.00	0.00	0.16	0.13	0.08	0.11	0.11	0.13
9	4DH7W-GC-OW-5	0.45	0.18	0.08	0.74	0.66	0.50	0.08	0.68	0.55	0.53
10	59HQR-OW-OW-1	0.16	0.18	0.37	0.82	0.79	0.63	0.76	0.68	0.71	0.84
11	59HQR-OW-GC-2	0.16	0.18	0.37	0.82	0.79	0.82	0.76	0.32	0.71	0.74
12	59HQR-OW-OW-3	0.58	0.00	0.26	0.16	0.79	0.87	0.89	0.68	0.71	0.95
13	59HQR-OW-GC-4	0.58	0.00	0.26	0.16	0.66	0.87	0.76	0.68	0.71	0.87
14	59HQR-OW-OW-5	0.74	0.84	0.97	0.61	0.61	0.66	0.76	0.66	0.55	0.76
15	59HQR-GC-OW-6	0.32	0.74	0.18	0.61	0.76	0.66	0.29	0.68	0.68	0.63
16	59HQR-OW-GC-7	0.45	0.42	0.37	0.16	0.34	0.24	0.29	0.32	0.00	0.24
17	59HQR-OW-GC-8	0.11	0.42	0.26	0.16	0.24	0.37	0.29	0.45	0.29	0.34
18	5M2N7-OW-GC-1	0.21	0.42	0.37	0.16	0.24	0.26	0.29	0.24	0.29	0.32
19	5M2N7-GC-OW-2	0.97	0.97	1.00	0.82	0.79	0.87	0.89	0.68	0.71	0.95
20	5M2N7-OW-GC-3	0.82	0.42	0.37	0.16	0.08	0.26	0.18	0.11	0.29	0.18
21	9BW2Q-OW-GC-1	0.95	0.42	0.37	0.42	0.39	0.37	0.29	0.32	0.29	0.37
22	9BW2Q-OW-GC-2	0.74	0.74	0.89	0.74	0.79	0.82	0.89	0.68	0.71	0.92
23	9BW2Q-OW-GC-3	0.74	0.84	0.26	0.16	0.50	0.26	0.08	0.11	0.21	0.26
24	9BW2Q-GC-OW-4	0.45	0.39	0.16	0.16	0.24	0.50	0.29	0.45	0.45	0.45
25	9BW2Q-OW-OW-5	0.05	0.18	0.37	0.61	0.79	0.66	0.89	0.68	0.71	0.89
26	9BW2Q-OW-GC-6	0.05	0.18	0.37	0.61	0.08	0.13	0.26	0.05	0.08	0.11
27	9BW2Q-OW-GC-7	0.03	0.18	0.03	0.00	0.00	0.13	0.00	0.00	0.00	0.00
28	Q97Y2-OW-OW-1	0.21	0.42	0.37	0.16	0.24	0.00	0.03	0.32	0.00	0.05
29	Q97Y2-OW-GC-2	0.21	0.42	0.37	0.16	0.03	0.00	0.03	0.05	0.11	0.03
30	Q97Y2-OW-GC-3	0.58	0.18	0.03	0.05	0.66	0.50	0.63	0.53	0.55	0.61
31	Q97Y2-GC-OW-4	0.58	0.42	0.18	0.74	0.50	0.05	0.29	0.61	0.55	0.50
32	TW1RK-OW-OW-1	0.82	0.08	0.79	0.53	0.03	0.13	0.61	0.53	0.11	0.29
33	TW1RK-OW-GC-2	0.82	0.08	0.79	0.53	0.50	0.66	0.74	0.50	0.50	0.58
34	TW1RK-GC-OW-3	0.58	0.74	0.79	0.45	0.34	0.66	0.29	0.24	0.45	0.45

35	TW1RK-GC-OW-4	0.32	0.82	0.37	0.45	0.66	0.87	0.63	0.68	0.55	0.82
36	XK9DJ-OW-OW-1	0.32	0.13	0.08	0.08	0.39	0.66	0.18	0.32	0.39	0.42
37	XK9DJ-OW-GC-2	0.32	0.13	0.08	0.08	0.18	0.26	0.18	0.11	0.21	0.18
38	XK9DJ-OW-OW-3	0.82	1.00	0.24	0.82	0.79	0.87	0.89	0.68	0.71	0.95
39	XK9DJ-GC-OW-4	0.97	0.84	0.37	0.82	0.79	0.45	0.58	0.68	0.71	0.63

APPENDIX XI. FUZZY CALIBRATION RESULTS FOR PERSONALITY - INDIVIDUAL LEVEL

Cases	EX	AG	CO	NE	OP
0AQD71	0.24	0.32	0.02	0.98	0.00
0AQD72	0.18	0.50	0.97	0.00	0.86
0AQD73	0.01	1.00	0.98	0.95	0.91
0AQD74	0.01	1.00	0.98	0.95	0.91
4DH7W1	0.00	1.00	1.00	0.01	1.00
4DH7W2	0.24	0.02	0.88	0.05	0.83
4DH7W3	0.40	0.07	0.00	0.07	0.00
4DH7W4	0.00	0.00	0.06	1.00	0.00
4DH7W5	1.00	0.76	0.00	0.95	0.50
59HQR1	0.00	1.00	1.00	0.05	0.99
59HQR2	0.00	1.00	1.00	0.05	0.99
59HQR3	0.50	1.00	0.50	1.00	0.99
59HQR4	0.50	1.00	0.50	1.00	0.99
59HQR5	0.81	0.01	0.98	0.50	0.50
59HQR6	1.00	1.00	1.00	1.00	1.00
59HQR7	0.95	0.00	0.91	1.00	0.11
59HQR8	0.99	0.95	0.10	0.98	0.00
5M2N71	0.50	0.01	0.03	1.00	0.50
5M2N72	0.09	1.00	0.91	0.01	0.00
5M2N73	0.09	0.02	0.73	1.00	0.91
9BW2Q1	1.00	1.00	0.00	0.50	0.95
9BW2Q2	0.02	0.95	0.73	0.01	0.98
9BW2Q3	0.88	0.76	0.99	0.76	0.86
9BW2Q4	0.95	0.64	0.50	0.02	0.00
9BW2Q5	0.99	0.02	1.00	0.00	0.00
9BW2Q6	0.99	0.02	1.00	0.00	0.00
9BW2Q7	1.00	0.25	0.84	0.08	0.50
Q97Y21	0.02	0.00	0.00	0.13	0.95
Q97Y22	0.02	0.00	0.00	0.13	0.95
Q97Y23	0.92	0.00	0.91	0.01	0.00
Q97Y24	1.00	1.00	0.99	1.00	1.00
TW1RK1	0.00	0.13	0.00	0.50	0.50
TW1RK2	0.00	0.13	0.00	0.50	0.50
TW1RK3	0.06	0.32	0.00	0.01	0.00
TW1RK4	0.95	0.00	0.10	0.02	0.00
XK9DJ1	1.00	0.95	0.24	0.50	0.97
XK9DJ2	1.00	0.95	0.24	0.50	0.97
XK9DJ3	0.00	0.76	0.00	0.76	0.00
XK9DJ4	1.00	0.07	0.00	0.50	0.50

APPENDIX XII. FUZZY CALIBRATION RESULTS FOR TEAM PERFORMANCE - INDIVIDUAL LEVEL

Cases	TMS	SVGC	CRP	CIS	TRP	TP
0AQD71	0.03	0.01	0.50	0.00	0.05	0.02
0AQD72	0.81	0.50	0.90	0.95	0.95	0.90
0AQD73	0.98	0.50	0.84	0.95	0.95	0.90
0AQD74	0.24	0.18	0.50	0.05	0.25	0.18
4DH7W1	0.50	1.00	0.95	0.60	0.95	0.96
4DH7W2	0.43	0.35	0.94	0.84	0.50	0.65
4DH7W3	0.01	0.01	0.00	0.01	0.02	0.01
4DH7W4	0.02	0.01	0.00	0.01	0.02	0.01
4DH7W5	0.90	0.50	0.00	0.95	0.68	0.58
59HQR1	0.98	0.92	0.95	0.95	0.95	0.98
59HQR2	0.98	1.00	0.95	0.11	0.95	0.94
59HQR3	0.98	1.00	0.98	0.95	0.95	1.00
59HQR4	0.90	1.00	0.95	0.95	0.95	0.99
59HQR5	0.81	0.95	0.95	0.93	0.68	0.96
59HQR6	0.98	0.95	0.50	0.95	0.93	0.82
59HQR7	0.15	0.04	0.50	0.11	0.01	0.04
59HQR8	0.05	0.18	0.50	0.36	0.11	0.14
5M2N71	0.05	0.06	0.50	0.05	0.11	0.10
5M2N72	0.98	1.00	0.98	0.95	0.95	1.00
5M2N73	0.01	0.06	0.01	0.01	0.11	0.02
9BW2Q1	0.24	0.18	0.50	0.11	0.11	0.18
9BW2Q2	0.98	1.00	0.98	0.95	0.95	0.99
9BW2Q3	0.50	0.06	0.00	0.01	0.05	0.06
9BW2Q4	0.05	0.50	0.50	0.36	0.37	0.35
9BW2Q5	0.98	0.95	0.98	0.95	0.95	0.99
9BW2Q6	0.01	0.01	0.24	0.01	0.01	0.01
9BW2Q7	0.00	0.01	0.00	0.00	0.01	0.00
Q97Y21	0.05	0.00	0.00	0.11	0.01	0.01
Q97Y22	0.01	0.00	0.00	0.01	0.02	0.00
Q97Y23	0.90	0.50	0.90	0.60	0.68	0.78
Q97Y24	0.50	0.01	0.50	0.84	0.68	0.50
TW1RK1	0.01	0.01	0.88	0.60	0.02	0.08
TW1RK2	0.50	0.95	0.95	0.50	0.50	0.72
TW1RK3	0.15	0.95	0.50	0.05	0.37	0.35
TW1RK4	0.90	1.00	0.90	0.95	0.68	0.98
XK9DJ1	0.24	0.95	0.01	0.11	0.25	0.28
XK9DJ2	0.03	0.06	0.01	0.01	0.05	0.02
XK9DJ3	0.98	1.00	0.98	0.95	0.95	1.00
XK9DJ4	0.98	0.35	0.86	0.95	0.95	0.82

APPENDIX XII. ANALYSIS OF NECESSITY RESULTS FOR HIGH TEAM PERFORMANCE (INDIV. LEVEL) - FULL TABLE

ID	Configurations	inclN	RoN	covN
1	CRP	0.919	0.794	0.802
2	TRP	0.918	0.957	0.951
3	EX+AG	0.903	0.472	0.604
4	~EX+TMS	0.956	0.521	0.652
5	EX+TMS	0.919	0.509	0.629
6	~EX+SVGC	0.925	0.544	0.649
7	EX+SVGC	0.936	0.465	0.617
8	~EX+CIS	0.966	0.512	0.652
9	AG+~NE	0.928	0.383	0.579
10	AG+~OP	0.901	0.365	0.558
11	~AG+TMS	0.958	0.399	0.600
12	AG+TMS	0.955	0.641	0.713
13	~AG+SVGC	0.926	0.397	0.583
14	AG+SVGC	0.92	0.637	0.697
15	~AG+CIS	0.907	0.420	0.583
16	AG+CIS	0.966	0.606	0.699
17	~CO+TMS	0.942	0.397	0.591
18	CO+TMS	0.957	0.636	0.712
19	CO+SVGC	0.966	0.584	0.687
20	~CO+CIS	0.905	0.425	0.585
21	CO+CIS	0.953	0.600	0.690
22	~NE+TMS	0.968	0.543	0.667
23	NE+TMS	0.909	0.515	0.627
24	~NE+SVGC	0.929	0.569	0.663
25	NE+SVGC	0.927	0.449	0.606
26	~NE+CIS	0.969	0.532	0.662
27	~OP+TMS	0.934	0.522	0.642
28	OP+TMS	0.943	0.529	0.65
29	OP+SVGC	0.960	0.505	0.646
30	~OP+CIS	0.901	0.527	0.630
31	OP+CIS	0.953	0.515	0.647
32	~TMS+SVGC	0.906	0.251	0.520
33	TMS+~SVGC	0.929	0.251	0.531
34	TMS+SVGC	0.978	0.826	0.843
35	TMS+~CRP	0.930	0.383	0.580
36	~TMS+CIS	0.901	0.233	0.511
37	TMS+~CIS	0.930	0.239	0.528
38	TMS+CIS	0.946	0.851	0.855
39	TMS+~TRP	0.934	0.232	0.528
40	SVGC+CIS	0.984	0.796	0.823
41	~CRP+CIS	0.901	0.362	0.557

42	CIS+~TRP	0.901	0.238	0.513
43	~EX+~AG+CO	0.913	0.305	0.542
44	~EX+AG+CO	0.914	0.210	0.511
45	~EX+~AG+NE	0.991	0.166	0.535
46	~EX+~AG+OP	0.984	0.171	0.533
47	~EX+~AG+~CRP	0.923	0.202	0.513
48	~EX+CO+~NE	0.903	0.286	0.53
49	~EX+CO+NE	0.933	0.218	0.522
50	EX+CO+NE	0.943	0.256	0.54
51	~EX+CO+~OP	0.919	0.263	0.53
52	~EX+CO+OP	0.927	0.257	0.532
53	EX+CO+~OP	0.924	0.247	0.528
54	EX+CO+OP	0.916	0.306	0.544
55	~EX+~NE+OP	0.949	0.234	0.536
56	~EX+NE+~OP	0.955	0.185	0.523
57	EX+~NE+OP	0.941	0.242	0.534
58	EX+NE+OP	0.904	0.222	0.509
59	EX+NE+CIS	0.901	0.296	0.533
60	~AG+CO+NE	0.97	0.182	0.53
61	AG+CO+NE	0.911	0.328	0.549
62	~AG+~CO+OP	0.950	0.119	0.501
63	~AG+CO+~OP	0.923	0.230	0.522
64	~AG+CO+OP	0.950	0.206	0.527
65	AG+CO+OP	0.912	0.366	0.564
66	~AG+~NE+OP	0.952	0.175	0.519
67	~AG+NE+OP	0.934	0.168	0.508
68	~AG+OP+~CRP	0.907	0.198	0.504
69	~CO+~NE+OP	0.976	0.116	0.513
70	CO+~NE+~OP	0.917	0.275	0.534
71	CO+~NE+OP	0.926	0.325	0.556
72	CO+NE+~OP	0.959	0.266	0.551
73	~CO+~OP+SVGC	0.914	0.290	0.537
74	CO+~OP+~SVGC	0.909	0.188	0.502
75	CO+~OP+~CRP	0.908	0.192	0.502
76	~CO+SVGC+~CRP	0.923	0.227	0.521
77	~CO+SVGC+~TRP	0.922	0.188	0.508
78	~NE+OP+~CRP	0.909	0.243	0.519
79	~NE+OP+~CIS	0.905	0.201	0.503
80	~OP+SVGC+~CRP	0.923	0.237	0.524
81	~OP+SVGC+~CIS	0.901	0.221	0.508
82	~OP+SVGC+~TRP	0.918	0.197	0.508
83	SVGC+~CRP+~TRP	0.906	0.211	0.507
84	AG+CO+~SVGC+~TRP	0.932	0.161	0.505
85	CO+NE+OP+~CRP	0.910	0.194	0.504
86	CO+NE+~SVGC+~TRP	0.916	0.174	0.500

APPENDIX XIV. ANALYSIS OF NECESSITY RESULTS FOR LOW TEAM PERFORMANCE (INDV. LEVEL) - FULL TABLE

ID	Configurations	inclN	RoN	covN
1	~TMS	0.917	0.899	0.895
2	~TRP	0.953	0.922	0.923
3	EX+~AG	0.924	0.498	0.636
4	EX+~CO	0.902	0.500	0.626
5	~EX+~SVGC	0.946	0.431	0.617
6	EX+~SVGC	0.952	0.537	0.667
7	~EX+~CIS	0.934	0.477	0.631
8	EX+~CIS	0.959	0.492	0.649
9	~AG+NE	0.904	0.433	0.598
10	~AG+OP	0.905	0.278	0.539
11	~AG+~SVGC	0.942	0.628	0.71
12	AG+~SVGC	0.970	0.376	0.607
13	~AG+~CRP	0.922	0.620	0.697
14	~AG+~CIS	0.949	0.579	0.686
15	AG+~CIS	0.948	0.404	0.607
16	~CO+~SVGC	0.977	0.592	0.705
17	CO+~SVGC	0.92	0.394	0.589
18	~CO+~CRP	0.922	0.671	0.727
19	~CO+~CIS	0.957	0.609	0.706
20	CO+~CIS	0.928	0.379	0.588
21	~NE+~SVGC	0.976	0.388	0.614
22	NE+~SVGC	0.947	0.599	0.696
23	NE+~CRP	0.914	0.647	0.708
24	~NE+~CIS	0.912	0.457	0.612
25	NE+~CIS	0.960	0.552	0.678
26	~OP+~SVGC	0.951	0.575	0.686
27	OP+~SVGC	0.956	0.441	0.626
28	~OP+~CRP	0.912	0.616	0.690
29	~OP+~CIS	0.936	0.584	0.684
30	OP+~CIS	0.961	0.427	0.622
31	TMS+~SVGC	0.936	0.258	0.548
32	TMS+~CIS	0.952	0.248	0.553
33	~SVGC+~CRP	0.970	0.797	0.826
34	~SVGC+CRP	0.945	0.239	0.546
35	~SVGC+~CIS	0.991	0.740	0.795
36	~SVGC+CIS	0.925	0.302	0.557
37	SVGC+~CIS	0.935	0.310	0.565
38	~SVGC+TRP	0.948	0.274	0.559
39	~CRP+~CIS	0.946	0.810	0.828
40	CRP+~CIS	0.958	0.224	0.548
41	~CIS+TRP	0.952	0.262	0.557

42	~EX+AG+CO	0.926	0.216	0.529
43	~EX+AG+~OP	0.936	0.160	0.517
44	~EX+AG+~CRP	0.925	0.332	0.568
45	~EX+CO+NE	0.911	0.218	0.522
46	~EX+CO+~CRP	0.921	0.269	0.544
47	~EX+NE+~OP	0.912	0.182	0.511
48	EX+NE+OP	0.911	0.228	0.525
49	~EX+~NE+~CRP	0.910	0.259	0.535
50	EX+~NE+~CRP	0.917	0.269	0.542
51	~EX+OP+~CRP	0.901	0.324	0.553
52	EX+OP+~CRP	0.926	0.261	0.544
53	EX+~CRP+CIS	0.915	0.242	0.532
54	AG+~CO+~OP	0.916	0.173	0.510
55	~AG+~CO+TMS	0.916	0.197	0.518
56	~AG+~CO+CRP	0.916	0.201	0.519
57	~AG+~CO+TRP	0.904	0.180	0.506
58	AG+~NE+~CRP	0.911	0.188	0.513
59	~CO+~NE+OP	0.943	0.115	0.507
60	~CO+NE+~OP	0.944	0.351	0.584
61	~CO+NE+OP	0.906	0.289	0.543
62	~EX+~AG+~CO+~NE	0.915	0.218	0.524
63	~EX+AG+~CO+~NE	0.938	0.106	0.502
64	~EX+~AG+~CO+~OP	0.907	0.226	0.522
65	~EX+~AG+~CO+SVGC	0.908	0.155	0.501
66	~EX+~AG+~CO+CIS	0.933	0.129	0.506
67	~EX+AG+~NE+OP	0.909	0.168	0.506
68	EX+AG+TMS+~CRP	0.907	0.196	0.513
69	EX+AG+SVGC+~CRP	0.915	0.162	0.507
70	EX+AG+~CRP+TRP	0.907	0.189	0.511
71	~EX+~CO+~NE+~OP	0.908	0.244	0.529
72	~EX+CO+~NE+~OP	0.917	0.212	0.523
73	~EX+CO+~NE+OP	0.915	0.160	0.506
74	EX+CO+~NE+~OP	0.933	0.157	0.514
75	~EX+~CO+~NE+TMS	0.918	0.151	0.505
76	~EX+~CO+~NE+CRP	0.922	0.161	0.510
77	~EX+~CO+~NE+TRP	0.901	0.164	0.500
78	~EX+~CO+~OP+TMS	0.934	0.147	0.512
79	~EX+~CO+~OP+CRP	0.916	0.163	0.508
80	~EX+CO+OP+CRP	0.907	0.177	0.507
81	~EX+~CO+~OP+TRP	0.916	0.155	0.505
82	EX+CO+TMS+~CRP	0.906	0.167	0.504
83	EX+CO+~CRP+TRP	0.906	0.171	0.505
84	~EX+~NE+OP+CRP	0.910	0.150	0.501
85	~AG+CO+~NE+~OP	0.941	0.174	0.524
86	AG+CO+~NE+~OP	0.925	0.152	0.509
87	AG+CO+NE+OP	0.902	0.251	0.528

88	AG+~CO+NE+TMS	0.902	0.173	0.503
89	AG+~CO+NE+SVGC	0.902	0.200	0.511
90	AG+~CO+NE+TRP	0.902	0.183	0.506
91	~AG+CO+~OP+CRP	0.912	0.150	0.502
92	AG+CO+OP+~CRP	0.923	0.239	0.535
93	~AG+~CO+~OP+CIS	0.904	0.201	0.513
94	AG+CO+TMS+~CRP	0.905	0.181	0.507
95	AG+CO+SVGC+~CRP	0.913	0.163	0.506
96	AG+CO+~CRP+CIS	0.929	0.165	0.514
97	AG+CO+~CRP+TRP	0.905	0.196	0.512
98	AG+SVGC+~CRP+CIS	0.904	0.162	0.501
99	CO+NE+OP+SVGC	0.911	0.158	0.503
100	CO+~NE+OP+~CRP	0.913	0.198	0.517
101	CO+NE+OP+CRP	0.923	0.150	0.507
102	CO+OP+SVGC+~CRP	0.905	0.170	0.504
103	CO+OP+~CRP+CIS	0.903	0.194	0.510
104	~EX+~AG+CO+~NE+CRP	0.902	0.162	0.500
105	~EX+~AG+~NE+~OP+TMS	0.922	0.141	0.504
106	~EX+~AG+~NE+~OP+CRP	0.909	0.194	0.513
107	~EX+~AG+~NE+~OP+TRP	0.909	0.157	0.502
108	~AG+CO+~NE+SVGC+CRP	0.916	0.140	0.501
109	~AG+~NE+~OP+TMS+CRP	0.903	0.170	0.503
110	~AG+~NE+~OP+SVGC+CRP	0.901	0.186	0.507
111	CO+NE+OP+CIS+TRP	0.902	0.187	0.508

APPENDIX XV. CALIBRATED FUZZIFICATION RESULTS FOR PERSONALITY AND TEAM CRITERIA - TEAM LEVEL

Cases	**EX**	**AG**	**CO**	**NE**	**OP**	**TMS**	**SVGC**	**CRP**	**CIS**	**TRP**	**TP**
0AQD7	0.00	1.00	0.96	0.26	0.74	0.93	0.02	0.30	0.30	0.95	0.70
4DH7W	0.04	0.25	0.04	1.00	0.00	0.02	0.07	0.02	0.73	0.07	0.07
59HQR	0.74	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5M2N7	0.25	0.04	0.25	0.97	0.04	0.30	0.70	0.93	0.02	0.30	0.30
9BW2Q	1.00	0.74	1.00	0.00	0.25	0.70	0.30	0.07	0.00	0.02	0.02
Q97Y2	0.96	0.00	0.74	0.04	1.00	0.00	0.00	0.00	0.07	0.00	0.00
TW1RK	0.00	0.00	0.00	0.01	0.00	0.07	0.99	0.99	0.95	0.73	0.93
XK9DJ	1.00	0.96	0.00	0.75	0.96	0.99	0.93	0.70	0.95	0.95	0.99

APPENDIX XVI. ANALYSIS OF NECESSITY RESULTS FOR HIGH TEAM PERFORMANCE (TEAMS) - FULL TABLE

ID	Configurations	incl	PRI	cov.r
1	TRP	0.94	0.92	0.94
2	TMS+SVGC	1.00	1.00	0.75
3	TMS+CRP	0.99	0.98	0.71
4	TMS+CIS	1.00	1.00	0.71
5	AG+SVGC	0.99	0.99	0.71
6	OP+SVGC	0.99	0.99	0.69
7	~EX+CIS	0.99	0.99	0.69
8	AG+CRP	0.99	0.99	0.68
9	AG+CIS	0.93	0.92	0.68
10	OP+CRP	0.98	0.98	0.67
11	~EX+SVGC	0.99	0.98	0.66
12	OP+CIS	0.93	0.92	0.66
13	~EX+NE	0.94	0.93	0.65
14	~CO+CRP	0.90	0.89	0.65
15	~EX+CRP	0.93	0.92	0.65
16	~CO+SVGC+CIS	0.90	0.88	0.65
17	EX+~NE	0.91	0.89	0.64
18	~NE+TMS	0.99	0.98	0.64
19	~NE+OP	0.91	0.90	0.64
20	~EX+TMS	1.00	1.00	0.62
21	CO+SVGC	0.99	0.98	0.62
22	~NE+SVGC	0.99	0.98	0.62
23	~EX+AG	0.99	0.99	0.62
24	~CO+TMS	1.00	1.00	0.61
25	~OP+TMS	1.00	1.00	0.60
26	OP+~TMS	0.99	0.99	0.60
27	AG+~NE	0.93	0.92	0.60
28	~CO+OP	1.00	1.00	0.60
29	AG+~CO	1.00	1.00	0.60
30	~AG+OP	0.99	0.99	0.60
31	CO+CIS	0.98	0.98	0.60
32	AG+~OP	0.99	0.99	0.60
33	~SVGC+CIS	0.99	0.99	0.58
34	SVGC+~CIS	0.99	0.98	0.58
35	CO+CRP	0.92	0.91	0.58
36	EX+SVGC+CRP	0.90	0.89	0.58
37	~NE+CIS	0.92	0.92	0.58
38	~NE+CRP	0.91	0.90	0.58
39	~EX+OP	0.99	0.99	0.57
40	~CO+~OP+CIS	0.90	0.89	0.57
41	~CO+~TMS+CIS	0.90	0.88	0.57

42	~CRP+CIS	0.93	0.92	0.57
43	CRP+~CIS	0.93	0.91	0.57
44	~AG+~CO+CIS	0.90	0.89	0.56
45	~AG+TMS	1.00	1.00	0.55
46	SVGC+~CRP	0.99	0.98	0.55
47	AG+~TMS	0.99	0.99	0.54
48	EX+SVGC+CIS	0.90	0.88	0.54
49	EX+~TMS+~CRP	0.94	0.92	0.53
50	EX+CO+~TMS	1.00	1.00	0.53
51	~CO+NE+~CRP	1.00	1.00	0.53
52	~CO+NE+~CIS	1.00	1.00	0.53
53	EX+CIS+~TRP	0.90	0.88	0.52
54	~CO+NE+~SVGC	1.00	1.00	0.52
55	EX+CRP+CIS	0.90	0.89	0.52
56	EX+~CO+~CRP	0.94	0.92	0.52
57	EX+~AG+~CIS	0.94	0.92	0.52
58	EX+~AG+CO	1.00	1.00	0.52
59	EX+~TMS+CIS	0.90	0.88	0.52
60	NE+~TMS+~CRP	0.94	0.93	0.52
61	EX+~CO+CIS	0.90	0.88	0.52
62	~CO+CIS+~TRP	0.90	0.88	0.51
63	~SVGC+CRP	0.93	0.92	0.51
64	NE+~TMS+~SVGC	0.94	0.94	0.51
65	EX+~AG+CRP	0.90	0.89	0.51
66	EX+~AG+CIS	0.90	0.89	0.51
67	~AG+NE+~CRP	0.94	0.93	0.51
68	NE+~OP+~CRP	0.94	0.93	0.51
69	NE+~TMS+~CIS	0.94	0.93	0.51
70	NE+~OP+~CIS	0.94	0.93	0.51
71	EX+~TMS+~SVGC	0.94	0.92	0.51
72	EX+~TMS+~CIS	0.94	0.92	0.51
73	EX+~CO+~CIS	0.94	0.92	0.51
74	~AG+NE+~SVGC	0.94	0.94	0.51
75	CO+NE+~OP	0.94	0.94	0.51
76	EX+CO+~OP	1.00	1.00	0.51
77	EX+~OP+~CIS	0.94	0.93	0.51
78	~AG+NE+~CIS	0.94	0.93	0.51
79	EX+~AG+~CRP	0.94	0.92	0.51
80	EX+~OP+~CRP	0.94	0.92	0.51
81	NE+~OP+~SVGC	0.94	0.94	0.51
82	EX+CRP+~TRP	0.90	0.89	0.51
83	EX+~CO+~SVGC	0.94	0.93	0.50
84	EX+NE+CIS	0.90	0.89	0.50
85	EX+~TMS+CRP	0.90	0.89	0.50
86	EX+NE+CRP	0.90	0.89	0.50

APPENDIX XVII. FULL TRUTH TABLE

	EX	AG	CO	NE	OP	TMS	SVGC	CRP	CIS	TRP	OUT	n	incl	PRI
1	0	0	0	0	0	0	0	0	0	0	0	1	0.413149	0
641	1	0	1	0	0	0	0	0	0	0	0	1	0.373427	0.008118
225	0	0	1	1	1	0	0	0	0	0	0	1	0.266478	0.003836
65	0	0	0	1	0	0	0	0	0	0	0	1	0.195358	0
33	0	0	0	0	1	0	0	0	0	0	0	2	0.143343	0
448	0	1	1	0	1	1	1	1	1	1	1	2	1	1
352	0	1	0	1	0	1	1	1	1	1	1	1	1	1
416	0	1	1	0	0	1	1	1	1	1	1	1	1	1
446	0	1	1	0	1	1	1	1	0	1	1	1	1	1
544	1	0	0	0	0	1	1	1	1	1	1	1	1	1
672	1	0	1	0	0	1	1	1	1	1	1	1	1	1
6	0	0	0	0	0	0	0	1	0	1	?	0	1	-
8	0	0	0	0	0	0	0	1	1	1	?	0	1	-
11	0	0	0	0	0	0	1	0	1	0	?	0	1	1
12	0	0	0	0	0	0	1	0	1	1	?	0	1	1
15	0	0	0	0	0	0	1	1	1	0	?	0	1	1
16	0	0	0	0	0	0	1	1	1	1	?	0	1	1
21	0	0	0	0	0	1	0	1	0	0	?	0	1	-
22	0	0	0	0	0	1	0	1	0	1	?	0	1	-
23	0	0	0	0	0	1	0	1	1	0	?	0	1	-
24	0	0	0	0	0	1	0	1	1	1	?	0	1	-
25	0	0	0	0	0	1	1	0	0	0	?	0	1	1
26	0	0	0	0	0	1	1	0	0	1	?	0	1	1
27	0	0	0	0	0	1	1	0	1	0	?	0	1	1
28	0	0	0	0	0	1	1	0	1	1	?	0	1	1
29	0	0	0	0	0	1	1	1	0	0	?	0	1	1
30	0	0	0	0	0	1	1	1	0	1	?	0	1	1
31	0	0	0	0	0	1	1	1	1	0	?	0	1	1
32	0	0	0	0	0	1	1	1	1	1	?	0	1	1
38	0	0	0	0	1	0	0	1	0	1	?	0	1	-
40	0	0	0	0	1	0	0	1	1	1	?	0	1	-
41	0	0	0	0	1	0	1	0	0	0	?	0	1	1
42	0	0	0	0	1	0	1	0	0	1	?	0	1	1
43	0	0	0	0	1	0	1	0	1	0	?	0	1	1
44	0	0	0	0	1	0	1	0	1	1	?	0	1	1
45	0	0	0	0	1	0	1	1	0	0	?	0	1	1
46	0	0	0	0	1	0	1	1	0	1	?	0	1	1
47	0	0	0	0	1	0	1	1	1	0	?	0	1	1
48	0	0	0	0	1	0	1	1	1	1	?	0	1	1
53	0	0	0	0	1	1	0	1	0	0	?	0	1	-
54	0	0	0	0	1	1	0	1	0	1	?	0	1	-
55	0	0	0	0	1	1	0	1	1	0	?	0	1	-
56	0	0	0	0	1	1	0	1	1	1	?	0	1	-
57	0	0	0	0	1	1	1	0	0	0	?	0	1	1
58	0	0	0	0	1	1	1	0	0	1	?	0	1	1
59	0	0	0	0	1	1	1	0	1	0	?	0	1	1
60	0	0	0	0	1	1	1	0	1	1	?	0	1	1
61	0	0	0	0	1	1	1	1	0	0	?	0	1	1
62	0	0	0	0	1	1	1	1	0	1	?	0	1	1
63	0	0	0	0	1	1	1	1	1	0	?	0	1	1
64	0	0	0	0	1	1	1	1	1	1	?	0	1	1
72	0	0	0	1	0	0	0	1	1	1	?	0	1	-
75	0	0	0	1	0	0	1	0	1	0	?	0	1	1
76	0	0	0	1	0	0	1	0	1	1	?	0	1	1
77	0	0	0	1	0	0	1	1	0	0	?	0	1	1
78	0	0	0	1	0	0	1	1	0	1	?	0	1	1
79	0	0	0	1	0	0	1	1	1	0	?	0	1	1
80	0	0	0	1	0	0	1	1	1	1	?	0	1	1
88	0	0	0	1	0	1	0	1	1	1	?	0	1	-
89	0	0	0	1	0	1	1	0	0	0	?	0	1	1

90	0	0	0	1	0	1	1	0	0	1	?	0	1	1
91	0	0	0	1	0	1	1	0	1	0	?	0	1	1
92	0	0	0	1	0	1	1	0	1	1	?	0	1	1
93	0	0	0	1	0	1	1	1	0	0	?	0	1	1
94	0	0	0	1	0	1	1	1	0	1	?	0	1	1
95	0	0	0	1	0	1	1	1	1	0	?	0	1	1
96	0	0	0	1	0	1	1	1	1	1	?	0	1	1
104	0	0	0	1	1	0	0	1	1	1	?	0	1	-
107	0	0	0	1	1	0	1	0	1	0	?	0	1	1
108	0	0	0	1	1	0	1	0	1	1	?	0	1	1
109	0	0	0	1	1	0	1	1	0	0	?	0	1	1
110	0	0	0	1	1	0	1	1	0	1	?	0	1	1
111	0	0	0	1	1	0	1	1	1	0	?	0	1	1
112	0	0	0	1	1	0	1	1	1	1	?	0	1	1
118	0	0	0	1	1	1	0	1	0	1	?	0	1	-
120	0	0	0	1	1	1	0	1	1	1	?	0	1	-
121	0	0	0	1	1	1	1	0	0	0	?	0	1	1
122	0	0	0	1	1	1	1	0	0	1	?	0	1	1
123	0	0	0	1	1	1	1	0	1	0	?	0	1	1
124	0	0	0	1	1	1	1	0	1	1	?	0	1	1
125	0	0	0	1	1	1	1	1	0	0	?	0	1	1
126	0	0	0	1	1	1	1	1	0	1	?	0	1	1
127	0	0	0	1	1	1	1	1	1	0	?	0	1	1
128	0	0	0	1	1	1	1	1	1	1	?	0	1	1
130	0	0	1	0	0	0	0	0	0	1	?	0	1	1
131	0	0	1	0	0	0	0	0	1	0	?	0	1	1
132	0	0	1	0	0	0	0	0	1	1	?	0	1	1
133	0	0	1	0	0	0	0	1	0	0	?	0	1	1
134	0	0	1	0	0	0	0	1	0	1	?	0	1	1
135	0	0	1	0	0	0	0	1	1	0	?	0	1	1
136	0	0	1	0	0	0	0	1	1	1	?	0	1	1
137	0	0	1	0	0	0	1	0	0	0	?	0	1	1
138	0	0	1	0	0	0	1	0	0	1	?	0	1	1
139	0	0	1	0	0	0	1	0	1	0	?	0	1	1
140	0	0	1	0	0	0	1	0	1	1	?	0	1	1
141	0	0	1	0	0	0	1	1	0	0	?	0	1	1
142	0	0	1	0	0	0	1	1	0	1	?	0	1	1
143	0	0	1	0	0	0	1	1	1	0	?	0	1	1
144	0	0	1	0	0	0	1	1	1	1	?	0	1	1
146	0	0	1	0	0	1	0	0	0	1	?	0	1	1
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892	1	1	0	1	1	1	1	0	1	1	?	0	0.998978	0.992063
860	1	1	0	1	0	1	1	0	1	1	?	0	0.998871	0.988235

884	1	1	0	1	1	1	0	0	1	1	?	0	0.998821	0.987013
1020	1	1	1	1	1	1	1	0	1	1	?	0	0.998752	0.997326
891	1	1	0	1	1	1	1	0	1	0	?	0	0.998739	0.98
604	1	0	0	1	0	1	1	0	1	1	?	0	0.998634	0.5
540	1	0	0	0	0	1	1	0	1	1	?	0	0.998619	0.988636
1012	1	1	1	1	1	1	0	0	1	1	?	0	0.998596	0
859	1	1	0	1	0	1	1	0	1	0	?	0	0.998557	0.888889
996	1	1	1	1	1	0	0	0	1	1	?	0	0.998549	0
603	1	0	0	1	0	1	1	0	1	0	?	0	0.998536	0.5
883	1	1	0	1	1	1	0	0	1	0	?	0	0.998492	0
539	1	0	0	0	0	1	1	0	1	0	?	0	0.998433	0.988636
636	1	0	0	1	1	1	1	0	1	1	?	0	0.998415	0.5
668	1	0	1	0	0	1	1	0	1	1	?	0	0.998333	0.989691
635	1	0	0	1	1	1	1	0	1	0	?	0	0.998282	0.5
667	1	0	1	0	0	1	1	0	1	0	?	0	0.998179	0.989691
1011	1	1	1	1	1	1	0	0	1	0	?	0	0.998138	0
875	1	1	0	1	1	0	1	0	1	0	?	0	0.998131	0.978723
876	1	1	0	1	1	0	1	0	1	1	?	0	0.998102	0.978723
587	1	0	0	1	0	0	1	0	1	0	?	0	0.998062	0.5
995	1	1	1	1	1	0	0	0	1	0	?	0	0.998054	0
796	1	1	0	0	0	1	1	0	1	1	?	0	0.99798	0.961538
844	1	1	0	1	0	0	1	0	1	1	?	0	0.997972	0.888889
828	1	1	0	0	1	1	1	0	1	1	?	0	0.997951	0.928571
660	1	0	1	0	0	1	0	0	1	1	?	0	0.997938	0.933333
588	1	0	0	1	0	0	1	0	1	1	?	0	0.997912	0.5
827	1	1	0	0	1	1	1	0	1	0	?	0	0.997908	0.928571
795	1	1	0	0	0	1	1	0	1	0	?	0	0.997904	0.961538
811	1	1	0	0	1	0	1	0	1	0	?	0	0.997738	0.909091
572	1	0	0	0	1	1	1	0	1	1	?	0	0.997701	0.928571
659	1	0	1	0	0	1	0	0	1	0	?	0	0.997696	0.933333
812	1	1	0	0	1	0	1	0	1	1	?	0	0.997696	0.909091
619	1	0	0	1	1	0	1	0	1	0	?	0	0.99759	0.5
867	1	1	0	1	1	0	0	0	1	0	?	0	0.997549	0
820	1	1	0	0	1	1	0	0	1	1	?	0	0.997525	0
868	1	1	0	1	1	0	0	0	1	1	?	0	0.9975	0
819	1	1	0	0	1	1	0	0	1	0	?	0	0.997462	0
715	1	0	1	1	0	0	1	0	1	0	?	0	0.997449	0.8
731	1	0	1	1	0	1	1	0	1	0	?	0	0.997429	0.8
620	1	0	0	1	1	0	1	0	1	1	?	0	0.997354	0.5
1019	1	1	1	1	1	1	1	0	1	0	?	0	0.997305	0.98
803	1	1	0	0	1	0	0	0	1	0	?	0	0.99723	0
924	1	1	1	0	0	1	1	0	1	1	?	0	0.99723	0.969697
716	1	0	1	1	0	0	1	0	1	1	?	0	0.997183	0.8
804	1	1	0	0	1	0	0	0	1	1	?	0	0.997167	0
732	1	0	1	1	0	1	1	0	1	1	?	0	0.997159	0.8
571	1	0	0	0	1	1	1	0	1	0	?	0	0.997135	0.928571
700	1	0	1	0	1	1	1	0	1	1	?	0	0.996997	0.941176
956	1	1	1	0	1	1	1	0	1	1	?	0	0.996997	0.928571
684	1	0	1	0	1	0	1	0	1	1	?	0	0.99697	0.928571
940	1	1	1	0	1	0	1	0	1	1	?	0	0.99697	0.909091
1003	1	1	1	1	1	0	1	0	1	0	?	0	0.996923	0.978723
1004	1	1	1	1	1	0	1	0	1	1	?	0	0.996923	0.978723
916	1	1	1	0	0	1	0	0	1	1	?	0	0.996885	0.875
708	1	0	1	1	0	0	0	0	1	1	?	0	0.996855	0.75
724	1	0	1	1	0	1	0	0	1	1	?	0	0.996825	0.75
555	1	0	0	0	1	0	1	0	1	0	?	0	0.996805	0.909091
556	1	0	0	0	1	0	1	0	1	1	?	0	0.996805	0.909091
676	1	0	1	0	1	0	0	0	1	1	?	0	0.996785	0.75
692	1	0	1	0	1	1	0	0	1	1	?	0	0.996785	0.75
971	1	1	1	1	0	0	1	0	1	0	?	0	0.996785	0.888889
972	1	1	1	1	0	0	1	0	1	1	?	0	0.996785	0.888889
923	1	1	1	0	0	1	1	0	1	0	?	0	0.996774	0.969697
747	1	0	1	1	1	0	1	0	1	0	?	0	0.996644	0.8
763	1	0	1	1	1	1	1	0	1	0	?	0	0.99661	0.8

699	1	0	1	0	1	1	1	0	1	0	?	0	0.996454	0.941176
955	1	1	1	0	1	1	1	0	1	0	?	0	0.996454	0.928571
963	1	1	1	1	0	0	0	0	1	0	?	0	0.996429	0
964	1	1	1	1	0	0	0	0	1	1	?	0	0.996429	0
683	1	0	1	0	1	0	1	0	1	0	?	0	0.996416	0.928571
939	1	1	1	0	1	0	1	0	1	0	?	0	0.996416	0.909091
915	1	1	1	0	0	1	0	0	1	0	?	0	0.996296	0.875
987	1	1	1	1	0	1	1	0	1	0	?	0	0.996183	0.888889
988	1	1	1	1	0	1	1	0	1	1	?	0	0.996183	0.888889
748	1	0	1	1	1	0	1	0	1	1	?	0	0.996169	0.8
675	1	0	1	0	1	0	0	0	1	0	?	0	0.996154	0.75
691	1	0	1	0	1	1	0	0	1	0	?	0	0.996154	0.75
764	1	0	1	1	1	1	1	0	1	1	?	0	0.996124	0.8
740	1	0	1	1	1	0	0	0	1	1	?	0	0.995951	0.75
932	1	1	1	0	1	0	0	0	1	1	?	0	0.995951	0
948	1	1	1	0	1	1	0	0	1	1	?	0	0.995951	0
756	1	0	1	1	1	1	0	0	1	1	?	0	0.995902	0.75
979	1	1	1	1	0	1	0	0	1	0	?	0	0.995671	0
980	1	1	1	1	0	1	0	0	1	1	?	0	0.995671	0
628	1	0	0	1	1	1	0	0	1	1	?	0	0.995185	0
537	1	0	0	0	0	1	1	0	0	0	?	0	0.995122	0.923077
538	1	0	0	0	0	1	1	0	0	1	?	0	0.995122	0.923077
931	1	1	1	0	1	0	0	0	1	0	?	0	0.994898	0
947	1	1	1	0	1	1	0	0	1	0	?	0	0.994898	0
665	1	0	1	0	0	1	1	0	0	0	?	0	0.9947	0.943396
666	1	0	1	0	0	1	1	0	0	1	?	0	0.994624	0.943396
852	1	1	0	1	0	1	0	0	1	1	?	0	0.994193	0.938272
466	0	1	1	1	0	1	0	0	0	1	?	0	0.994169	0
601	1	0	0	1	0	1	1	0	0	0	?	0	0.994129	0.25
793	1	1	0	0	0	1	1	0	0	0	?	0	0.994059	0.892857
794	1	1	0	0	0	1	1	0	0	1	?	0	0.994059	0.892857
658	1	0	1	0	0	1	0	0	0	1	?	0	0.994	0.823529
656	1	0	1	0	0	0	1	1	1	1	?	0	0.993902	0.975
450	0	1	1	1	0	0	0	0	0	1	?	0	0.993691	0
602	1	0	0	1	0	1	1	0	0	1	?	0	0.993671	0.25
655	1	0	1	0	0	0	1	1	1	0	?	0	0.993377	0.970954
729	1	0	1	1	0	1	1	0	0	0	?	0	0.993333	0.571429
710	1	0	1	1	0	0	0	1	0	1	?	0	0.993127	0.777778
726	1	0	1	1	0	1	0	1	0	1	?	0	0.993127	0.777778
857	1	1	0	1	0	1	1	0	0	0	?	0	0.993072	0.727273
858	1	1	0	1	0	1	1	0	0	1	?	0	0.993072	0.727273
469	0	1	1	1	0	1	0	1	0	0	?	0	0.992857	0
470	0	1	1	1	0	1	0	1	0	1	?	0	0.992857	0
564	1	0	0	0	1	1	0	0	1	1	?	0	0.99284	0
730	1	0	1	1	0	1	1	0	0	1	?	0	0.992593	0.571429
851	1	1	0	1	0	1	0	0	1	0	?	0	0.992515	0
648	1	0	1	0	0	0	0	1	1	1	?	0	0.992188	0.885246
965	1	1	1	1	0	0	0	1	0	0	?	0	0.991968	0
966	1	1	1	1	0	0	0	1	0	1	?	0	0.991968	0
527	1	0	0	0	0	0	1	1	1	0	?	0	0.991963	0.924731
528	1	0	0	0	0	0	1	1	1	1	?	0	0.991963	0.924731
921	1	1	1	0	0	1	1	0	0	0	?	0	0.991957	0.914286
453	0	1	1	1	0	0	0	1	0	0	?	0	0.991903	0
454	0	1	1	1	0	0	0	1	0	1	?	0	0.991903	0
922	1	1	1	0	0	1	1	0	0	1	?	0	0.991781	0.914286
114	0	0	0	1	1	1	0	0	0	1	?	0	0.991736	0
116	0	0	0	1	1	1	0	0	1	1	?	0	0.991736	0
889	1	1	0	1	1	1	1	0	0	0	?	0	0.991655	0.890909
198	0	0	1	1	0	0	0	1	0	1	?	0	0.991632	0.777778
214	0	0	1	1	0	1	0	1	0	1	?	0	0.991632	0.777778
647	1	0	1	0	0	0	0	1	1	0	?	0	0.991304	0.681818
523	1	0	0	0	0	0	1	0	1	0	?	0	0.991209	0.914894
524	1	0	0	0	0	0	1	0	1	1	?	0	0.991209	0.914894
825	1	1	0	0	1	1	1	0	0	0	?	0	0.991163	0.684211

652	1	0	1	0	0	0	1	0	1	1	?	0	0.991131	0.920792
50	0	0	0	0	1	1	0	0	0	1	?	0	0.991111	0
52	0	0	0	0	1	1	0	0	1	1	?	0	0.991111	0
914	1	1	1	0	0	1	0	0	0	1	?	0	0.991071	0.7
890	1	1	0	1	1	1	1	0	0	1	?	0	0.990755	0.890909
985	1	1	1	1	0	1	1	0	0	0	?	0	0.990712	0.727273
519	1	0	0	0	0	0	0	1	1	0	?	0	0.990704	0
520	1	0	0	0	0	0	0	1	1	1	?	0	0.990704	0
651	1	0	1	0	0	0	1	0	1	0	?	0	0.990599	0.920792
986	1	1	1	1	0	1	1	0	0	1	?	0	0.990476	0.727273
826	1	1	0	0	1	1	1	0	0	1	?	0	0.990148	0.684211
981	1	1	1	1	0	1	0	1	0	0	?	0	0.990148	0
982	1	1	1	1	0	1	0	1	0	1	?	0	0.990148	0
596	1	0	0	1	0	1	0	0	1	1	?	0	0.990071	0
644	1	0	1	0	0	0	0	0	1	1	?	0	0.989835	0.578947
102	0	0	0	1	1	0	0	1	0	1	?	0	0.989547	0
912	1	1	1	0	0	0	1	1	1	1	?	0	0.989426	0.906667
783	1	1	0	0	0	0	1	1	1	0	?	0	0.989313	0.758621
784	1	1	0	0	0	0	1	1	1	1	?	0	0.989313	0.758621
779	1	1	0	0	0	0	1	0	1	0	?	0	0.98929	0.733333
780	1	1	0	0	0	0	1	0	1	1	?	0	0.98929	0.733333
525	1	0	0	0	0	0	1	1	0	0	?	0	0.989247	0.8
526	1	0	0	0	0	0	1	1	0	1	?	0	0.989247	0.8
842	1	1	0	1	0	0	1	0	0	1	?	0	0.989224	0.615385
788	1	1	0	0	0	1	0	0	1	1	?	0	0.989154	0
643	1	0	1	0	0	0	0	0	1	0	?	0	0.98913	0.578947
1017	1	1	1	1	1	1	1	0	0	0	?	0	0.988806	0.890909
904	1	1	1	0	0	0	0	1	1	1	?	0	0.9888	0.867925
787	1	1	0	0	0	1	0	0	1	0	?	0	0.988713	0
775	1	1	0	0	0	0	0	1	1	0	?	0	0.98871	0
776	1	1	0	0	0	0	0	1	1	1	?	0	0.98871	0
1018	1	1	1	1	1	1	1	0	0	1	?	0	0.988636	0.890909
532	1	0	0	0	0	1	0	0	1	1	?	0	0.988599	0
517	1	0	0	0	0	0	0	1	0	0	?	0	0.988266	0
518	1	0	0	0	0	0	0	1	0	1	?	0	0.988266	0
614	1	0	0	1	1	0	0	1	0	1	?	0	0.988189	0
273	0	1	0	0	0	1	0	0	0	0	?	0	0.988166	0
274	0	1	0	0	0	1	0	0	0	1	?	0	0.988166	0
908	1	1	1	0	0	0	1	0	1	1	?	0	0.987952	0.783784
911	1	1	1	0	0	0	1	1	1	0	?	0	0.987741	0.805556
275	0	1	0	0	0	1	0	0	1	0	?	0	0.98773	0
276	0	1	0	0	0	1	0	0	1	1	?	0	0.98773	0
900	1	1	1	0	0	0	0	0	1	1	?	0	0.987241	0.466667
953	1	1	1	0	1	1	1	0	0	0	?	0	0.987152	0.684211
907	1	1	1	0	0	0	1	0	1	0	?	0	0.986949	0.783784
954	1	1	1	0	1	1	1	0	0	1	?	0	0.986928	0.684211
722	1	0	1	1	0	1	0	0	0	1	?	0	0.986911	0.375
903	1	1	1	0	0	0	0	1	1	0	?	0	0.986891	0.5
653	1	0	1	0	0	0	1	1	0	0	?	0	0.986592	0.863636
654	1	0	1	0	0	0	1	1	0	1	?	0	0.986592	0.863636
612	1	0	0	1	1	0	0	0	1	1	?	0	0.986559	0
970	1	1	1	1	0	0	1	0	0	1	?	0	0.986486	0.615385
18	0	0	0	0	0	1	0	0	0	1	?	0	0.986456	0
899	1	1	1	0	0	0	0	0	1	0	?	0	0.986111	0.466667
20	0	0	0	0	0	1	0	0	1	1	?	0	0.986079	0
1010	1	1	1	1	1	1	0	0	0	1	?	0	0.985849	0
633	1	0	0	1	1	1	1	0	0	0	?	0	0.985437	0.142857
818	1	1	0	0	1	1	0	0	0	1	?	0	0.985112	0
785	1	1	0	0	0	1	0	0	0	0	?	0	0.985075	0
786	1	1	0	0	0	1	0	0	0	1	?	0	0.985075	0
882	1	1	0	1	1	1	0	0	0	1	?	0	0.984887	0
14	0	0	0	0	0	0	1	1	0	1	?	0	0.984791	0.929329
100	0	0	0	1	1	0	0	0	1	1	?	0	0.984615	0
522	1	0	0	0	0	0	1	0	0	1	?	0	0.984305	0.72

646	1	0	1	0	0	0	0	1	0	1	?	0	0.98401	0.535714
634	1	0	0	1	1	1	1	0	0	1	?	0	0.984	0.142857
530	1	0	0	0	0	1	0	0	0	1	?	0	0.983755	0
569	1	0	0	0	1	1	1	0	0	0	?	0	0.983607	0.684211
570	1	0	0	0	1	1	1	0	0	1	?	0	0.983607	0.684211
548	1	0	0	0	1	0	0	0	1	1	?	0	0.983444	0
36	0	0	0	0	1	0	0	0	1	1	?	0	0.983333	0
339	0	1	0	1	0	1	0	0	1	0	?	0	0.983264	0
340	0	1	0	1	0	1	0	0	1	1	?	0	0.983264	0
761	1	0	1	1	1	1	1	0	0	0	?	0	0.98324	0.4
978	1	1	1	1	0	1	0	0	0	1	?	0	0.983221	0
836	1	1	0	1	0	0	0	0	1	1	?	0	0.983015	0
697	1	0	1	0	1	1	1	0	0	0	?	0	0.982609	0.727273
698	1	0	1	0	1	1	1	0	0	1	?	0	0.982196	0.727273
84	0	0	0	1	0	1	0	0	1	1	?	0	0.981308	0
690	1	0	1	0	1	1	0	0	0	1	?	0	0.980952	0.333333
762	1	0	1	1	1	1	1	0	0	1	?	0	0.980831	0.4
650	1	0	1	0	0	0	1	0	0	1	?	0	0.980415	0.734375
962	1	1	1	1	0	0	0	0	0	1	?	0	0.98017	0
754	1	0	1	1	1	1	0	0	0	1	?	0	0.979933	0.333333
260	0	1	0	0	0	0	0	0	1	1	?	0	0.979472	0
771	1	1	0	0	0	0	0	0	1	0	?	0	0.979138	0
772	1	1	0	0	0	0	0	0	1	1	?	0	0.979138	0
626	1	0	0	1	1	1	0	0	0	1	?	0	0.978202	0
87	0	0	0	1	0	1	0	1	1	0	?	0	0.978193	0
642	1	0	1	0	0	0	0	0	0	1	?	0	0.977805	0.37931
210	0	0	1	1	0	1	0	0	0	1	?	0	0.977564	0.3
562	1	0	0	0	1	1	0	0	0	1	?	0	0.977143	0
195	0	0	1	1	0	0	0	0	1	0	?	0	0.976667	0.3
521	1	0	0	0	0	0	1	0	0	0	?	0	0.976641	0.631579
211	0	0	1	1	0	1	0	0	1	0	?	0	0.976431	0.3
516	1	0	0	0	0	0	0	0	1	1	?	0	0.976427	0
10	0	0	0	0	0	0	1	0	0	1	?	0	0.976105	0.705882
946	1	1	1	0	1	1	0	0	0	1	?	0	0.976096	0
4	0	0	0	0	0	0	0	0	1	1	?	0	0.975501	0
199	0	0	1	1	0	0	0	1	1	0	?	0	0.973881	0.5
215	0	0	1	1	0	1	0	1	1	0	?	0	0.973881	0.5
580	1	0	0	1	0	0	0	0	1	1	?	0	0.973742	0
117	0	0	0	1	1	1	0	1	0	0	?	0	0.973384	0
119	0	0	0	1	1	1	0	1	1	0	?	0	0.973384	0
649	1	0	1	0	0	0	1	0	0	0	?	0	0.97282	0.661972
324	0	1	0	1	0	0	0	0	1	1	?	0	0.972763	0
782	1	1	0	0	0	0	1	1	0	1	?	0	0.970674	0.52381
227	0	0	1	1	1	0	0	0	1	0	?	0	0.969828	0.3
243	0	0	1	1	1	1	0	0	1	0	?	0	0.969432	0.3
774	1	1	0	0	0	0	0	1	0	1	?	0	0.968992	0
969	1	1	1	1	0	0	1	0	0	0	?	0	0.968831	0.4
778	1	1	0	0	0	0	1	0	0	1	?	0	0.968354	0.468085
197	0	0	1	1	0	0	0	1	0	0	?	0	0.968198	0.4375
213	0	0	1	1	0	1	0	1	0	0	?	0	0.968198	0.4375
68	0	0	0	1	0	0	0	0	1	1	?	0	0.967836	0
229	0	0	1	1	1	0	0	1	0	0	?	0	0.96729	0.5
231	0	0	1	1	1	0	0	1	1	0	?	0	0.96729	0.5
245	0	0	1	1	1	1	0	1	0	0	?	0	0.96729	0.5
247	0	0	1	1	1	1	0	1	1	0	?	0	0.96729	0.5
598	1	0	0	1	0	1	0	1	0	1	?	0	0.966006	0
258	0	1	0	0	0	0	0	0	0	1	?	0	0.963788	0
853	1	1	0	1	0	1	0	1	0	0	?	0	0.962617	0
854	1	1	0	1	0	1	0	1	0	1	?	0	0.962617	0
910	1	1	1	0	0	0	1	1	0	1	?	0	0.961083	0.557692
86	0	0	0	1	0	1	0	1	0	1	?	0	0.960265	0
531	1	0	0	0	0	1	0	0	1	0	?	0	0.959484	0
906	1	1	1	0	0	0	1	0	0	1	?	0	0.959243	0.508772
515	1	0	0	0	0	0	0	0	1	0	?	0	0.958587	0

529	1	0	0	0	0	1	0	0	0	0	?	0	0.957821	0
902	1	1	1	0	0	0	0	1	0	1	?	0	0.957597	0.225806
874	1	1	0	1	1	0	1	0	0	1	?	0	0.956193	0.613333
898	1	1	1	0	0	0	0	0	0	1	?	0	0.956193	0.194444
849	1	1	0	1	0	1	0	0	0	0	?	0	0.956019	0
850	1	1	0	1	0	1	0	0	0	1	?	0	0.956019	0
594	1	0	0	1	0	1	0	0	0	1	?	0	0.955414	0
810	1	1	0	0	1	0	1	0	0	1	?	0	0.952846	0.25641
514	1	0	0	0	0	0	0	0	0	1	?	0	0.950762	0
770	1	1	0	0	0	0	0	0	0	1	?	0	0.950392	0
341	0	1	0	1	0	1	0	1	0	0	?	0	0.948936	0
342	0	1	0	1	0	1	0	1	0	1	?	0	0.948936	0
563	1	0	0	0	1	1	0	0	1	0	?	0	0.948276	0
1002	1	1	1	1	1	0	1	0	0	1	?	0	0.946097	0.613333
85	0	0	0	1	0	1	0	1	0	0	?	0	0.945087	0
2	0	0	0	0	0	0	0	0	0	1	?	0	0.941423	0
938	1	1	1	0	1	0	1	0	0	1	?	0	0.940574	0.25641
34	0	0	0	0	1	0	0	0	0	1	?	0	0.940239	0
337	0	1	0	1	0	1	0	0	0	0	?	0	0.939394	0
338	0	1	0	1	0	1	0	0	0	1	?	0	0.939394	0
561	1	0	0	0	1	1	0	0	0	0	?	0	0.936986	0
547	1	0	0	0	1	0	0	0	1	0	?	0	0.936909	0
82	0	0	0	1	0	1	0	0	0	1	?	0	0.934659	0
994	1	1	1	1	1	0	0	0	0	1	?	0	0.932243	0
73	0	0	0	1	0	0	1	0	0	0	?	0	0.927813	0.276596
843	1	1	0	1	0	0	1	0	1	0	?	0	0.927176	0.163265
866	1	1	0	1	1	0	0	0	0	1	?	0	0.926396	0
802	1	1	0	0	1	0	0	0	0	1	?	0	0.926209	0
586	1	0	0	1	0	0	1	0	0	1	?	0	0.922	0.025
74	0	0	0	1	0	0	1	0	0	1	?	0	0.921659	0.276596
1001	1	1	1	1	1	0	1	0	0	0	?	0	0.921569	0.511111
201	0	0	1	1	0	0	1	0	0	0	?	0	0.919811	0.105263
682	1	0	1	0	1	0	1	0	0	1	?	0	0.918768	0.309524
554	1	0	0	0	1	0	1	0	0	1	?	0	0.917847	0.25641
585	1	0	0	1	0	0	1	0	0	0	?	0	0.915441	0.021277
714	1	0	1	1	0	0	1	0	0	1	?	0	0.914474	0.093023
674	1	0	1	0	1	0	0	0	0	1	?	0	0.914201	0.09375
937	1	1	1	0	1	0	1	0	0	0	?	0	0.913894	0.185185
202	0	0	1	1	0	0	1	0	0	1	?	0	0.91029	0.105263
713	1	0	1	1	0	0	1	0	0	0	?	0	0.909449	0.08
838	1	1	0	1	0	0	0	1	0	1	?	0	0.909341	0
582	1	0	0	1	0	0	0	1	0	1	?	0	0.909091	0
70	0	0	0	1	0	0	0	1	0	1	?	0	0.907928	0
595	1	0	0	1	0	1	0	0	1	0	?	0	0.906425	0
105	0	0	0	1	1	0	1	0	0	0	?	0	0.904494	0.028571
845	1	1	0	1	0	0	1	1	0	0	?	0	0.904306	0.166667
847	1	1	0	1	0	0	1	1	1	0	?	0	0.904077	0.166667
841	1	1	0	1	0	0	1	0	0	0	?	0	0.903882	0.133333
681	1	0	1	0	1	0	1	0	0	0	?	0	0.903226	0.265306
627	1	0	0	1	1	1	0	0	1	0	?	0	0.900631	0
553	1	0	0	0	1	0	1	0	0	0	?	0	0.9	0.217391
17	0	0	0	0	0	1	0	0	0	0	?	0	0.897331	0
233	0	0	1	1	1	0	1	0	0	0	?	0	0.897281	0.105263
834	1	1	0	1	0	0	0	0	0	1	?	0	0.896552	0
13	0	0	0	0	0	0	1	1	0	0	?	0	0.895574	0.635266
19	0	0	0	0	0	1	0	0	1	0	?	0	0.894737	0
930	1	1	1	0	1	0	0	0	0	1	?	0	0.894161	0
106	0	0	0	1	1	0	1	0	0	1	?	0	0.893417	0.028571
259	0	1	0	0	0	0	0	0	1	0	?	0	0.893182	0
599	1	0	0	1	0	1	0	1	1	0	?	0	0.890244	0
234	0	0	1	1	1	0	1	0	0	1	?	0	0.881119	0.105263
583	1	0	0	1	0	0	0	1	1	0	?	0	0.880637	0
326	0	1	0	1	0	0	0	1	0	1	?	0	0.876866	0
817	1	1	0	0	1	1	0	0	0	0	?	0	0.876173	0

546	1	0	0	0	1	0	0	0	0	1	?	0	0.875354	0
881	1	1	0	1	1	1	0	0	0	0	?	0	0.874763	0
261	0	1	0	0	0	0	0	1	0	0	?	0	0.870748	0
579	1	0	0	1	0	0	0	0	1	0	?	0	0.870036	0
597	1	0	0	1	0	1	0	1	0	0	?	0	0.868966	0
289	0	1	0	0	1	0	0	0	0	0	?	0	0.868852	0
291	0	1	0	0	1	0	0	0	1	0	?	0	0.868852	0
323	0	1	0	1	0	0	0	0	1	0	?	0	0.867978	0
129	0	0	1	0	0	0	0	0	0	0	?	0	0.86722	0.044776
145	0	0	1	0	0	1	0	0	0	0	?	0	0.86722	0.044776
263	0	1	0	0	0	0	0	1	1	0	?	0	0.867133	0
498	0	1	1	1	1	1	0	0	0	1	?	0	0.866962	0.325843
353	0	1	0	1	1	0	0	0	0	0	?	0	0.864407	0
355	0	1	0	1	1	0	0	0	1	0	?	0	0.862543	0
611	1	0	0	1	1	0	0	0	1	0	?	0	0.861407	0
83	0	0	0	1	0	1	0	0	1	0	?	0	0.860636	0
593	1	0	0	1	0	1	0	0	0	0	?	0	0.857394	0
629	1	0	0	1	1	1	0	1	0	0	?	0	0.856688	0
631	1	0	0	1	1	1	0	1	1	0	?	0	0.856688	0
657	1	0	1	0	0	1	0	0	0	0	?	0	0.854484	0.14
625	1	0	0	1	1	1	0	0	0	0	?	0	0.853448	0
322	0	1	0	1	0	0	0	0	0	1	?	0	0.853035	0
401	0	1	1	0	0	1	0	0	0	0	?	0	0.852874	0
821	1	1	0	0	1	1	0	1	0	0	?	0	0.851852	0
618	1	0	0	1	1	0	1	0	0	1	?	0	0.850711	0.015625
617	1	0	0	1	1	0	1	0	0	0	?	0	0.849785	0.014085
885	1	1	0	1	1	1	0	1	0	0	?	0	0.849624	0
501	0	1	1	1	1	1	0	1	0	0	?	0	0.849246	0.354839
502	0	1	1	1	1	1	0	1	0	1	?	0	0.849246	0.354839
9	0	0	0	0	0	0	1	0	0	0	?	0	0.844008	0.241206
706	1	0	1	1	0	0	0	0	0	1	?	0	0.841202	0.038961
465	0	1	1	1	0	1	0	0	0	0	?	0	0.840964	0
385	0	1	1	0	0	0	0	0	0	0	?	0	0.840796	0
615	1	0	0	1	1	0	0	1	1	0	?	0	0.839858	0
745	1	0	1	1	1	0	1	0	0	0	?	0	0.839817	0.054054
3	0	0	0	0	0	0	0	0	1	0	?	0	0.839527	0
113	0	0	0	1	1	1	0	0	0	0	?	0	0.839394	0
115	0	0	0	1	1	1	0	0	1	0	?	0	0.839394	0
746	1	0	1	1	1	0	1	0	0	1	?	0	0.836364	0.059701
707	1	0	1	1	0	0	0	0	1	0	?	0	0.832941	0.040541
723	1	0	1	1	0	1	0	0	1	0	?	0	0.831754	0.040541
327	0	1	0	1	0	0	0	1	1	0	?	0	0.831361	0
449	0	1	1	1	0	0	0	0	0	0	?	0	0.830334	0
49	0	0	0	0	1	1	0	0	0	0	?	0	0.828996	0
51	0	0	0	0	1	1	0	0	1	0	?	0	0.828996	0
433	0	1	1	0	1	1	0	0	0	0	?	0	0.827493	0.311828
81	0	0	0	1	0	1	0	0	0	0	?	0	0.826185	0
777	1	1	0	0	0	0	1	0	0	0	?	0	0.824353	0.118919
711	1	0	1	1	0	0	0	1	1	0	?	0	0.817232	0.090909
727	1	0	1	1	0	1	0	1	1	0	?	0	0.817232	0.090909
781	1	1	0	0	0	0	1	1	0	0	?	0	0.814268	0.127168
293	0	1	0	0	1	0	0	1	0	0	?	0	0.813725	0
295	0	1	0	0	1	0	0	1	1	0	?	0	0.813725	0
209	0	0	1	1	0	1	0	0	0	0	?	0	0.812065	0.035714
482	0	1	1	1	1	0	0	0	0	1	?	0	0.809639	0
67	0	0	0	1	0	0	0	0	1	0	?	0	0.807183	0
194	0	0	1	1	0	0	0	0	0	1	?	0	0.806045	0.0375
773	1	1	0	0	0	0	0	1	0	0	?	0	0.805412	0
357	0	1	0	1	1	0	0	1	0	0	?	0	0.802768	0
359	0	1	0	1	1	0	0	1	1	0	?	0	0.802768	0
739	1	0	1	1	1	0	0	0	1	0	?	0	0.8017	0.041096
905	1	1	1	0	0	0	1	0	0	0	?	0	0.80072	0.148718
755	1	0	1	1	1	1	0	0	1	0	?	0	0.8	0.041096
913	1	1	1	0	0	1	0	0	0	0	?	0	0.798595	0.075269

257	0	1	0	0	0	0	0	0	0	0	?	0	0.797244	0
161	0	0	1	0	1	0	0	0	0	0	?	0	0.794212	0.044776
177	0	0	1	0	1	1	0	0	0	0	?	0	0.794212	0.044776
417	0	1	1	0	1	0	0	0	0	0	?	0	0.79288	0
241	0	0	1	1	1	1	0	0	0	0	?	0	0.79056	0.040541
909	1	1	1	0	0	0	1	1	0	0	?	0	0.786704	0.15847
578	1	0	0	1	0	0	0	0	0	1	?	0	0.780645	0
901	1	1	1	0	0	0	0	1	0	0	?	0	0.775393	0.042683
610	1	0	0	1	1	0	0	0	0	1	?	0	0.775148	0
486	0	1	1	1	1	0	0	1	0	1	?	0	0.774929	0
977	1	1	1	1	0	1	0	0	0	0	?	0	0.773779	0
645	1	0	1	0	0	0	0	1	0	0	?	0	0.772201	0.059761
98	0	0	0	1	1	0	0	0	0	1	?	0	0.763723	0
497	0	1	1	1	1	1	0	0	0	0	?	0	0.762906	0.189542
738	1	0	1	1	1	0	0	0	0	1	?	0	0.762376	0.030303
741	1	0	1	1	1	0	0	1	0	0	?	0	0.762069	0.092105
743	1	0	1	1	1	0	0	1	1	0	?	0	0.762069	0.092105
757	1	0	1	1	1	1	0	1	0	0	?	0	0.762069	0.092105
759	1	0	1	1	1	1	0	1	1	0	?	0	0.762069	0.092105
725	1	0	1	1	0	1	0	1	0	0	?	0	0.75463	0.061947
66	0	0	0	1	0	0	0	0	0	1	?	0	0.74635	0
226	0	0	1	1	1	0	0	0	0	1	?	0	0.746082	0.035714
873	1	1	0	1	1	0	1	0	0	0	?	0	0.73716	0.149837
809	1	1	0	0	1	0	1	0	0	0	?	0	0.724101	0.0369
99	0	0	0	1	1	0	0	0	1	0	?	0	0.690196	0
721	1	0	1	1	0	1	0	0	0	0	?	0	0.687296	0.015385
835	1	1	0	1	0	0	0	0	1	0	?	0	0.682825	0
961	1	1	1	1	0	0	0	0	0	0	?	0	0.679463	0
193	0	0	1	1	0	0	0	0	0	0	?	0	0.662432	0.015873
769	1	1	0	0	0	0	0	0	0	0	?	0	0.661818	0
35	0	0	0	0	1	0	0	0	1	0	?	0	0.661435	0
689	1	0	1	0	1	1	0	0	0	0	?	0	0.631474	0.015957
5	0	0	0	0	0	0	0	1	0	0	?	0	0.62704	0
839	1	1	0	1	0	0	0	1	1	0	?	0	0.611599	0
545	1	0	0	0	1	0	0	0	0	0	?	0	0.589695	0
945	1	1	1	0	1	1	0	0	0	0	?	0	0.577626	0
513	1	0	0	0	0	0	0	0	0	0	?	0	0.575586	0
753	1	0	1	1	1	1	0	0	0	0	?	0	0.570946	0.011673
897	1	1	1	0	0	0	0	0	0	0	?	0	0.569272	0.014228
7	0	0	0	0	0	0	0	1	1	0	?	0	0.554268	0
37	0	0	0	0	1	0	0	1	0	0	?	0	0.506934	0
805	1	1	0	0	1	0	0	1	0	0	?	0	0.489796	0
1009	1	1	1	1	1	1	0	0	0	0	?	0	0.487414	0
869	1	1	0	1	1	0	0	1	0	0	?	0	0.484945	0
71	0	0	0	1	0	0	0	1	1	0	?	0	0.473039	0
481	0	1	1	1	1	0	0	0	0	0	?	0	0.469304	0
737	1	0	1	1	1	0	0	0	0	0	?	0	0.456072	0.007075
485	0	1	1	1	1	0	0	1	0	0	?	0	0.455611	0
325	0	1	0	1	0	0	0	1	0	0	?	0	0.448855	0
321	0	1	0	1	0	0	0	0	0	0	?	0	0.446575	0
39	0	0	0	0	1	0	0	1	1	0	?	0	0.4375	0
103	0	0	0	1	1	0	0	1	1	0	?	0	0.432718	0
709	1	0	1	1	0	0	0	1	0	0	?	0	0.415287	0.015021
609	1	0	0	1	1	0	0	0	0	0	?	0	0.398517	0
613	1	0	0	1	1	0	0	1	0	0	?	0	0.393981	0
833	1	1	0	1	0	0	0	0	0	0	?	0	0.392352	0
705	1	0	1	1	0	0	0	0	0	0	?	0	0.387411	0.004323
837	1	1	0	1	0	0	0	1	0	0	?	0	0.38	0
581	1	0	0	1	0	0	0	1	0	0	?	0	0.37312	0
577	1	0	0	1	0	0	0	0	0	0	?	0	0.364336	0
993	1	1	1	1	1	0	0	0	0	0	?	0	0.354221	0
101	0	0	0	1	1	0	0	1	0	0	?	0	0.343891	0
865	1	1	0	1	1	0	0	0	0	0	?	0	0.330547	0
801	1	1	0	0	1	0	0	0	0	0	?	0	0.312006	0

673	1	0	1	0	1	0	0	0	0	0	?	0	0.311089	0.004255
97	0	0	0	1	1	0	0	0	0	0	?	0	0.304985	0
929	1	1	1	0	1	0	0	0	0	0	?	0	0.282682	0
69	0	0	0	1	0	0	0	1	0	0	?	0	0.271851	0

APPENDIX XVIII. PERSONALITY QUESTIONNAIRE

Personality Questionnaire

Thank you for agreeing to participate in this personality questionnaire. Your input is crucial for understanding the effect personality traits have on overall team performance in construction projects. The research focuses on construction teams with the primary organizations. Primary organizations are:
1) Owner/agency
2) The design team
3) The construction team
4) Consultant team 5) Major subcontractor

Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner. As a description of you, indicate for each statement whether it is:
1. Very Inaccurate
2. Moderately Inaccurate
3. Neither Accurate nor Inaccurate
4. Moderately Accurate
5. Very Accurate

This personality questionnaire should take 10-15 minutes and it is recommended that you complete the questionnaire all at once. Your participation is voluntary, and your responses will be kept confidential. Your responses will not be reported in any manner that can be associated with any specific individual, organization, project, agency, or program.

If you have any questions or concerns about this personality questionnaire or this research project, please contact:
Arlys Silva Payne at 601-466-3238 or asilv19@lsu.edu

I understand the previous information and voluntarily consent to participate in the personality questionnaire

○ Yes, continue with survey

○ No, opt out of survey

Skip To: End of Survey If Answer = No, opt out of survey

Q1) Please state ***your organization's role in this project***:

- ◯ Owner/Owner Agency (1)
- ◯ Construction Manager/Owner's Representative (2)
- ◯ Architect / Engineer (3)
- ◯ General Contractor (4)
- ◯ Subcontractor (5)
- ◯ Consultant (6)
- ◯ Other, please specify: (7) ____________________

Q2	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Am the life of the party.	◯	◯	◯	◯	◯

Q3	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Don't talk a lot.	◯	◯	◯	◯	◯

Q4	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Feel comfortable around people.	◯	◯	◯	◯	◯

Q5	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Keep in the background.	◯	◯	◯	◯	◯

Q6	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Start conversations.	◯	◯	◯	◯	◯

Q7	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Have little to say. (1)	○	○	○	○	○
Q8	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Talk to a lot of different people at parties.	○	○	○	○	○
Q9	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Don't like to draw attention to myself.	○	○	○	○	○
Q10	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Don't mind being the center of attention.	○	○	○	○	○
Q11	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Am quiet around strangers.	○	○	○	○	○

Q12	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Feel little concern for others.	○	○	○	○	○
Q13	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Am interested in people.	○	○	○	○	○
Q14	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Insult people.	○	○	○	○	○
Q15	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Sympathize with others' feelings.	○	○	○	○	○
Q16	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Am not interested in other people's problems.	○	○	○	○	○
Q17	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Have a soft heart.	○	○	○	○	○
Q18	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Am not really interested in others.	○	○	○	○	○
Q19	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Take time out for others.	○	○	○	○	○

Q20	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Feel others' emotions.	○	○	○	○	○
Q21	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Make people feel at ease.	○	○	○	○	○
Q22	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Am always prepared.	○	○	○	○	○
Q23	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Leave my belongings around.	○	○	○	○	○
Q29	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Shirk my duties.	○	○	○	○	○
Q30	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Follow a schedule.	○	○	○	○	○
Q31	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Am exacting in my work.	○	○	○	○	○
Q32	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Get stressed out easily.	○	○	○	○	○
Q33	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)

Am relaxed most of the time.					
Q34	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Worry about things.					
Q35	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Seldom feel blue.					
Q36	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Am easily disturbed.					
Q37	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Get upset easily.					
Q38	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Change my mood a lot.					
Q45	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Have a vivid imagination.					
Q39	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Have frequent mood swings.					
Q40	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Get irritated easily.					

Q41	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Often feel blue.	◯	◯	◯	◯	◯
Q42	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Am full of ideas.	◯	◯	◯	◯	◯
Q43	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Have a rich vocabulary.	◯	◯	◯	◯	◯
Q44	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Have difficulty understanding abstract ideas.	◯	◯	◯	◯	◯
Q46	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Am not interested in abstract ideas.	◯	◯	◯	◯	◯
47	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Have excellent ideas.	◯	◯	◯	◯	◯
Q48	Very Inaccurate (5)	Moderately Inaccurate (4)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (2)	Very Accurate (1)
Do not have a good imagination.	◯	◯	◯	◯	◯
Q49	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Am quick to understand things.	◯	◯	◯	◯	◯

Q50	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Use difficult words.	○	○	○	○	○

Q51	Very Inaccurate (1)	Moderately Inaccurate (2)	Neither Accurate Nor Inaccurate (3)	Moderately Accurate (4)	Very Accurate (5)
Spend time reflecting on things.	○	○	○	○	○

Q52) If you would like more information when the research is completed, please fill the contact information section. The results and explanations of the findings will be shared with you. Thank you for your cooperation and support.

○ Yes, continue with contact information (4)

○ No, finish personality questionnaire (5)

Skip To: End of Survey If Question 52 = No, finish personality questionnaire

Q56 Contact information:

○ Name (1) ____

○ Job Position (2) ____

○ Email (3) ____

○ Phone (8) ____

End of Survey

APPENDIX XIX. TEAM PERFORMANCE QUESTIONNAIRE

Team Performance Questionnaire

Introduction

Thank you for agreeing to participate in this questionnaire. Your input is crucial for understanding the effect that personality has on team performance with the primary team members and on the overall project success of a construction project. The purpose of this research is to investigate if personality differences influence construction team performance and ultimately the success of the construction project. Construction teams must relate to each other inter-personally during the construction phase. It is in this interaction where personality differences become apparent, which either leads to a loss of team performance when issues arise and escalate, or to project success when construction team members work effectively as a team. The primary team members in this questionnaire are:

- Owner/agency representative
- Design firm representative
- General Contractor firm representative
- Consultant firm representative
- Major Subcontractor firm representative

It is voluntary to participate in this questionnaire, and you can withdraw at any time without having to state a reason. No names or personal information will be registered or used. The information collected will be used in reports and articles to disseminate the research results, but no personal information will be included in these reports to protect the identity of all participants. IP addresses will be stored on faculty servers, but these will be permanently deleted when the data collection is completed. The Louisiana State University (LSU) Institutional Review Board (IRB) approved this dissertation research project. For details regarding research safety and regulations, please visit LSU IRB's web page at:

LSU IRB Web Page

If you have any questions or concerns about this questionnaire or this dissertation research project, please contact:

Arlys Silva Payne
Graduate Research Assistant
Louisiana State University
Phone: 601-466-3238
Email: asilv19@lsu.edu

Questionnaire Instructions

There are no right or wrong answers in this questionnaire. This questionnaire is collecting your opinions and experiences about the current construction project team you are working with on a construction project. Although some questions might not fit your point of view or you are unsure about a question, it is important that you answer the questions to the best of your knowledge. The researcher is aware that the construction project you are currently working on is in progress and that you might have never worked with one or several team members. In this case, answer the questions based on what you know or have experienced at this point with those team member(s).

Please think about your team members' interactions, behaviors, and performance and answer the questionnaire based on team performance. Team performance is defined as:

"*The ability of team members to work together to execute a project successfully, relying on their ability to integrate relevant experience, knowledge, and skills. Functionality between team members is dependent on their interpersonal relationships.*"

Your responses should be based on your current construction project and the associated project team, so please focus on the relationships with the team members in terms of this project.

The questionnaire is composed of the following sections:

Provide your role information (2-3 minutes to complete) – Basic information about your firm and your role in the project.
Rate team composition (3-5 minutes to complete) – Rate specific questions regarding team composition.
Rate team information system (3-5 minutes to complete) – Rate the ease of accessing project information.
Rate team productive outputs (3-5 minutes to complete) – Rate how the team meets their responsibilities and makes decisions that meets project goals.
Rate team survivability (3-5 minutes to complete) – Rate the capability of team members working again in the future.
Rate the common attributes of team performance (5-7 minutes to complete) – Rate individual statements based on your perception of the team you are currently working with.

This questionnaire should take approximately 20-30 minutes and it is recommended that you complete the questionnaire all at once. Your participation is voluntary, and your responses will be kept confidential. Your responses will not be reported in any manner that can be associated with any specific individual, organization, project, agency, or program.

I understand the above information and voluntarily consent to participate in the research questionnaire

○ Yes, continue with questionnaire

○ No, opt out of questionnaire

1) Please state ***your organization's role in this project***:

- ○ Owner/Owner Agency
- ○ Construction Manager/Owner’s Representative
- ○ Architect / Engineer
- ○ General Contractor
- ○ Subcontractor
- ○ Consultant
- ○ Other, please specify: ____

2) Please state your role with your organization:

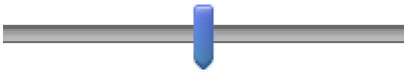
- ○ Project manager
- ○ Project engineer
- ○ Architect
- ○ Design engineer
- ○ Construction Manager
- ○ Superintendent
- ○ Foreman
- ○ Estimator
- ○ Scheduler
- ○ Contract Administrator
- ○ Inspector
- ○ Other (please specify): ____

3) Please state how many ***years*** you have worked in the construction industry:

0 5 10 15 20 25 30 35 40 45 50

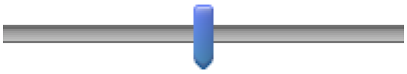
4) Please state how many ***years*** you have worked with your organization:

0 10 20 30 40 50 60 70 80 90 100



5) Please state how many years you have worked in your current position:

0 5 10 15 20 25 30 35 40 45 50



6) Please select your age range:

- 18-30
- 31-40
- 41-50
- 51-60
- 60 – Plus

7) Please select the highest degree or level of school you have completed. If currently in school, highest degree received.

- High School Diploma
- Some College
- Bachelor’s Degree
- Master’s Degree
- Doctorate Degree
- Trade/Technical Training
- Other

8) TC **Team Composition:** Team composition is defined as the adequate number of members needed to fulfill project tasks and goals. Please rate each statement to the best of your knowledge. There are no right or wrong answers as your response is your own perception.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
The team is the right size for the tasks required.	○	○	○	○	○
Team members have the expertise required to perform tasks well.	○	○	○	○	○
The mix of experience and knowledge of team members is appropriate.	○	○	○	○	○
There are signs that team members are so similar in personality that there is little for them to learn from one another.	○	○	○	○	○
There are signs that team members are so opposite in personality that they do not communicate well with one another.	○	○	○	○	○

9) TI **Team Access to Information -** Access to information is defined as ease of accessing to data needed to fulfill project tasks and goals. Please rate how much you agree with the following statements that occurred during the construction phase of this project.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
The team consistently has the right information to complete tasks.	○	○	○	○	○
The team shares with one another the information necessary to correct issues in a timely manner.	○	○	○	○	○
The team has a system to track performance to provide the team with feedback.	○	○	○	○	○
Team members rely on other team members with more experience.	○	○	○	○	○

10) TP **Team's Productive output** - Team's productive output refers to the degree the project team can meet the established goals to complete this project. Please rate how much you agree with the following statements that occurring during construction of this project.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
The team works together to control the budget and costs on the project.	○	○	○	○	○
The team works together to control the schedule and time changes on the project.	○	○	○	○	○
The team work together to establish milestones for cost and schedule evaluations	○	○	○	○	○
The team works together to address quality deficiencies.	○	○	○	○	○
The team tracks project quality to ensure issues are corrected in a timely manner.	○	○	○	○	○

11) TS **Team Survivability** - Please rate how much you agree with the following statements. Team Survivability is defined as the team's willingness to work together in future projects.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Team members would like to work with the same team members again on another project.	○	○	○	○	○
Working as a team helps improve team members' skills to work well with others.	○	○	○	○	○
Team members offer help to each other to complete tasks.	○	○	○	○	○
Team members feel satisfied when working together.	○	○	○	○	○

Common Attributes of Team Performance

The following pages include a series of statements for you to rate based on your experience in interacting with other team members on this project. Please answer each statement to the best of your knowledge. There are no right, or wrong answers, so be as accurate as you can.

Please **SELECT** and **RATE** the team member that you interact with the most. Please select all that apply):

- ◯ Owner/Agency team member
- ◯ Architect / Engineer team member
- ◯ General Contractor team member
- ◯ Consultant team member
- ◯ Subcontractor team member

12) Team Member Satisfaction (MS)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
${lm://Field/2} has a clear understanding of their own and other's roles and responsibilities	◯	◯	◯	◯	◯
The focus of ${lm://Field/2} is to successfully complete project goals and objectives	◯	◯	◯	◯	◯
${lm://Field/2} anticipates the ability to make cooperative adjustments to cope with changing circumstances or conditions	◯	◯	◯	◯	◯
${lm://Field/2} was proud that everyone in the team did their best to achieve project goals	◯	◯	◯	◯	◯

13) Shared Values/Goals/Culture (SVGC)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
${lm://Field/2} is concerned with everyone obtaining successful outcomes	◯	◯	◯	◯	◯
${lm://Field/2} trusts the other team members with their knowledge and abilities	◯	◯	◯	◯	◯
When a difference of opinion occurs, ${lm://Field/2} makes an effort to work out the issue internally, respectfully, and jointly with others	◯	◯	◯	◯	◯
${lm://Field/2} respects others and considers other's interests when making decisions	◯	◯	◯	◯	◯

14) Commitment & Responsibility (CR)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
${lm://Field/2} accommodates others when problems or needs arise	○	○	○	○	○
${lm://Field/2} is willing to make changes in work strategies based on changes during construction	○	○	○	○	○
${lm://Field/2} is open to modifying agreements and accepting changes when necessary	○	○	○	○	○
${lm://Field/2} is willing to give feedback to other team members	○	○	○	○	○

15) Communication & Information Sharing (CI)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
${lm://Field/2} is willing to share any necessary project information	○	○	○	○	○
${lm://Field/2} keeps others informed about events or changing conditions that can affect others or the project	○	○	○	○	○
${lm://Field/2} assures that all members have received important information	○	○	○	○	○
Others can ask the ${lm://Field/2} for an explanation when questions arise on how to perform tasks as planned	○	○	○	○	○

16) Trust & Respect (TR)

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
${lm://Field/2} respects others on the project and provides helpful feedback to the team	○	○	○	○	○
${lm://Field/2} could be trusted with their knowledge and experience.	○	○	○	○	○
${lm://Field/2} on this project is committed to others and to the success of the project	○	○	○	○	○
A supportive atmosphere exists for getting work done when working with ${lm://Field/2}	○	○	○	○	○

APPENDIX XX. INTERVIEW QUESTIONNAIRE

Interview Questions for Case Studies
Case Study:

1. What is your roll with the team?
2. Did you have previous working experience with current team members?
3. Do you enjoy working with each other?
    a. Why do you enjoy working with your current team members?
4. Does trust exist between team members?
    a. Explain how this trust was acquired.
5. Are you comfortable with each team member's personality, why or why not?
6. Has personality differences or similarities assisted or harmed team performance?
    a. Please give one or two main factors of how personality has assisted or harmed team performance.
7. Do you rather work with someone you get along with little experience or with someone who has a lot of experience but who is hard to get along with, explain why?
    a. Give an example of a situation in which that choice would have been beneficial.
8. How are tasks or issues solved, as a team or by an individual such as a team leader?
    a. If there is process used, please explain the process from information gathering, delivery of questions, how solutions are acquired, and distributed back to the team.
9. Are you proud with the performance of the team members?
    a. Give an example of a situation or accomplishment in which performance was consistent with, or exceeded, the goals for teamwork?
10. Were all team members' contributions to the team appreciated?
    a. Give an example how team members were appreciated.
11. Quality of Work for major working items: Rank each item based on the following scale:
    1 = Very poor, 2 = Poor, 3 = Acceptable, 4 = Good, 5 = Very Good

    Insert here major work items from the contract, for example:
    a. Removal of Concrete sidewalk & Driveways (1 2 3 4 5)
    b. Pavement Patching (1 2 3 4 5)
    c. Milling (1 2 3 4 5)
    d. Asphalt Concrete (1 2 3 4 5)
    e. Cleaning and Resealing Existing Longitudinal and Transverse (1 2 3 4 5)
    f. Full Depth Patching (1 2 3 4 5)
    g. Permanent Pavement Markings (1 2 3 4 5)
    h. Permanent Signalization (1 2 3 4 5)

12. Overall Safety of the Project:
    Score the following statements regarding overall project safety procedures or protocols in place?
    1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Very Often, 5 = Always

    a. Site workers have the proper PPE and equipment to perform the work (1 2 3 4 5)
    b. New hazards are discussed, and new measures are introduced (1 2 3 4 5)
    c. Do you feel you can address project safety issues to the project team? (1 2 3 4 5)
    d. Are the CDC's guidelines to prevent the spread of COVID-19 follow? (1 2 3 4 5)
    e. Are safety inspections perform occasionally (at least once per week)? (1 2 3 4 5)

APPENDIX XXI. IRB ACTION ON EXEMPTION APPROVAL REQUEST

ACTION ON EXEMPTION APPROVAL REQUEST

Institutional Review Board
Dr. Dennis Landin, Chair
130 David Boyd Hall
Baton Rouge, LA 70803
P: 225.578.8692
F: 225.578.5983
irb@lsu.edu
lsu.edu/research

TO: Arlys Payne
Bert S. Turner Department of Construction Management

FROM: Dennis Landin
Chair, Institutional Review Board

DATE: October 18, 2019

RE: IRB# E11764

TITLE: BIG FIVE FACTORS PERSONALITY TRAITS AS A TOOL FOR CONSTRUCTION TEAM PERFORMANCE FORECAST

New Protocol/Modification/Continuation: Modification

Brief Modification Description: New protocol for case studies, which serves as construct validity for my cases studies.

Review date: 10/18/2019

Approved X **Disapproved** ______

Approval Date: 10/18/2019 **Approval Expiration Date:** N/A

LSU Proposal Number (if applicable):

By: Dennis Landin, Chairman ______________

PRINCIPAL INVESTIGATOR: PLEASE READ THE FOLLOWING –
Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU's Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the individual participants including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
7. Notification of the IRB of a serious compliance failure.
8. **SPECIAL NOTE: Make sure you use bcc when emailing more than one recipient. Approvals will automatically be closed by the IRB on the expiration date unless the PI requests a continuation.**

**All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/irb*

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VITA

Arlys Silva Payne has a background in Construction Project Management, earning his bachelor's of Science in Construction Engineering Technology from The University of Southern Mississippi (USM) in 2006. Upon graduation, Arlys worked in heavy highway construction, starting in asphalt quality control (QCA) as a Roadway Technician, Assistant Project Manager, and Project Manager Engineer. He then proceeded to USM in 2013, earning a master's degree in Logistics, Trade, and Transportation in December 2014. After obtaining his master's degree, Arlys worked for a highway construction consulting engineering firm as a Project Administrator in North Carolina and Florida. Arlys enrolled in the Construction Management Ph.D. program at Louisiana State University in January 2016. Arlys served as a Research Assistant in the Bert S. Turner Department of Construction Management. During his Ph.D. program, Arlys worked as an Adjunct Professor at USM and later (May 2018) was hired as the Vice President of a construction company in Richmond, Virginia.